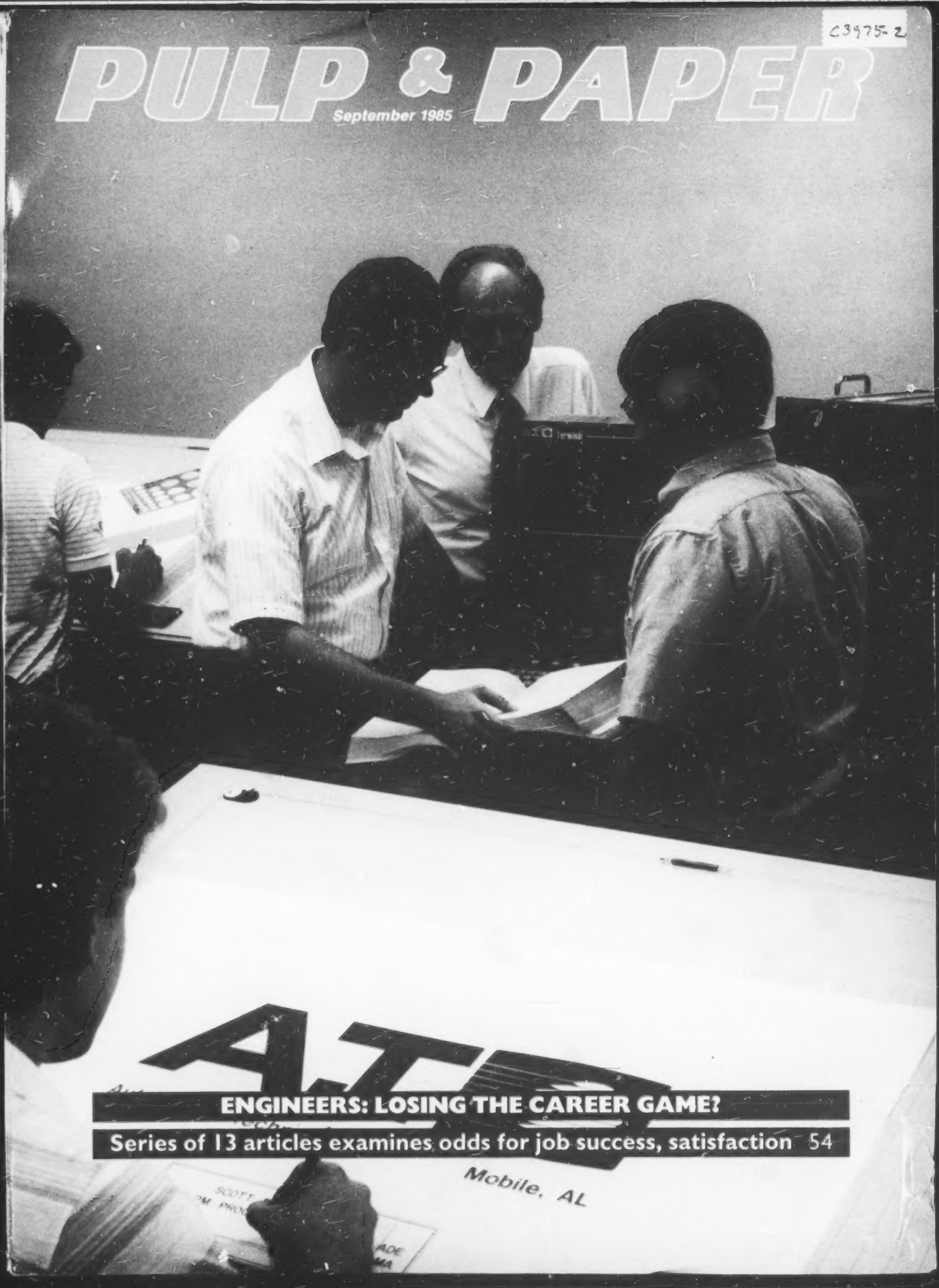
C3975-2

PULP & PAPER

September 1985



ENGINEERS: LOSING THE CAREER GAME?

Series of 13 articles examines odds for job success, satisfaction 54

Volume 59
Number 9

SEPTEMBER

FOCUS: ENGINEERING

Losing the career game? 54
P&P's special four-part report on engineering examines career options in the paper industry: from student to practitioner, manager, and beyond

STUDENT

56 Today's pulp and paper schools stress early career focus
59 Educational debate: humanities losing out to technology?
61 Miami U curriculum gets high marks from students, employers

ENGINEER

81 How does your salary stack up? Most pay in management, sales
86 Engineers speak out on stereotyping, promotions, pay
94 Climbing the corporate ladder: career planning programs
97 Avoiding a career dead end

MANAGER

107 The voice of experience: six engineers review their careers
111 Engineers at the top most likely came up via production, sales
114 Psychological profile: the traits that help make a manager

CONSULTANT

123 Why consulting? Ex-paper industry engineers on outside
127 From slide rule to CRT screen: the future of design engineering
130 When it's time to move on

OTHER FEATURES

PROCESS AUTOMATION

Bottom-up automation 137
Automating a pulp and paper mill in a step-by-step hierarchical approach ensures success in each segment

Three-tier control 140
Leaf River integrates supervisory control, digital instrumentation, business management functions

THE COVER

This issue focuses on engineers—how they are developing career-wise in the paper industry, and what direction the profession may be taking. The special report includes 13 articles in four parts. (Staff photo of engineers at Automation Technology Inc., Mobile, Ala., by Ken Patrick.)

PAPERMAKING

Seamed press felts 144
New fabric design allows use of heavier, stiffer fabrics

Paper stock agitator design 156
Axial flow impellers in agitation applications are a mechanically sound and energy-efficient design

Pulp strength parameter 173
A single number system for pulp strength characterization has been evaluated in lab and mill trials

Semihydraulic headbox 207
Improved hydraulic design allows headbox to equal the formation of units with rectifier rolls

MANAGEMENT

Interview with GNN chief 151
Great Northern Nekoosa's chairman and CEO, William R. Laidig, discusses dollar's impact on U.S. paper markets

Linerboard expansion 186
New technology has cut the cost of greenfield mills, but rebuilding existing mills is still better investment

EXPANSION/MODERNIZATION

SAPPI mill expansion 169
Flexibility, water conservation, top controls are keys to this South African newsprint and board expansion

PULPING

PGW trials 190
Four days of pressure grinding southern pine at Madison Paper produced good quality, few problems

TMP refiner feed 192
Chip feed improvements for twin-disc refiners permit higher feed rates and loadings, improved steam recovery

Green liquor clarification 212
Ultrahigh-molecular-weight polymers improve dregs removal and reduce lime kiln fuel consumption

CONFERENCES

Univ. of Maine meeting 210
The thirty-fifth annual Univ. of Maine Pulp & Paper Foundation Open House

PULP&PAPER

EDITORIAL STAFF

Editor	Ken L. Patrick	AT
Executive Editor	Kenneth E. Smith	AT
Executive News Editor	Willard E. Mies	SF
Senior Editor	John C.W. Evans	NY
Associate Editor	Dave R. Allan	NY
Engineering Editor	Matt Coleman	AT
Senior News Editor	Debra A. Adams	NY
Technical Editor	Michael J. Ducey	SF
News Editor	Carl P. Espe	SF
News Editor	Ted Blackman	SF
Consulting Editor	Stephanie Pollitzer	SF
Departments Editor	Elizabeth A. Smith	AT
Staff Editor	Maude Conrad	SF
Editorial Assistant	Suzanne Wright	SF
International Editors	John Kalish	BR
	John Pearson	BR
	Hugh O'Brian	BR
Managing Editor	Paula J. Irons	SF
Art Director	Ellen Zaslow	SF
Copy/Production Editor	Deborah S. Soliosi	SF
Copy/Production Editor	Regina M. McGrath	SF
Technical Artist	Janet Duncan	SF

Office locations

AT = Atlanta: 2700 Cumberland Parkway N.W., Suite 530, Atlanta, Ga. 30339; (404) 432-3186
SF = San Francisco: 500 Howard St., San Francisco, Calif. 94105; (415) 397-1881; Telex 278273
NY = New York: 370 Lexington Ave., New York, N.Y. 10017; (212) 683-9294; Telex 220442
BR = Brussels: Chaussée de Charleroi 123a, Boite 5, B-1060, Brussels, Belgium; Telex 846-24672

PUBLISHING HEADQUARTERS
San Francisco, California

Publishing Director	Leigh M. Freeman
Group Publisher	Leonard E. Haas
Director of Production	Andrew A. Mickus
Director of Circulation	Wini D. Ragus
Ad Production Coordinator	Mary Marrkand
Marketing Coordinator	Dana Baker
Statistical Assistant	Kimberly M. Johnson

Sales and business offices are listed on Advertisers' Index page

MILLER FREEMAN publications

Chairman of the Board ..... David R. Stevens
President ..... Marshall W. Freeman
Vice President ..... Charles C. Baake
Vice President ..... Leigh M. Freeman
Vice President ..... Leonard E. Haas
Vice President ..... Barbara M. Hampson
Vice President ..... Thomas L. Kemp
Vice President ..... Wini D. Ragus
Secretary/Treasurer ..... Miller Freeman III
Assistant Treasurer ..... Douglas M. Denny

PULP & PAPER (ISSN 0033-4081) is published monthly except November when semimonthly by MILLER FREEMAN PUBLICATIONS, 500 Howard St., San Francisco, Calif. 94105. Second class postage paid at San Francisco and at additional mailing office.
POSTMASTER: Please send Form 3579 to PULP & PAPER, 500 Howard St., San Francisco, Calif. 94105.

© Copyright 1985 by Miller Freeman Publications Inc. All rights reserved.

ABP BPA

Subscriptions & Address Change: Sent without charge to the U.S.A. & Canada (upon written request) to individuals in pulp, paper, and board manufacturing firms and paper converting firms. To all others there is a subscription charge of $45.00 a year in the U.S. All subscriptions to other countries: $65.00 a year, except Europe and Mediterranean, $75.00 (air service included). Single copy, $4.00, except Buyers Guide, $25.00. Photocopies of articles and complete microform volumes available through University Microfilms International, 300 N. Zeeb Rd., Ann Arbor, Mich. 48106.

Requests, subscription orders, and address changes must show name and position or job of individual, name and location of mill, plant or office where employed, and exact business or product produced at this location.

Send subscription correspondence to:
Circulation Department, PULP & PAPER,
500 Howard St., San Francisco, Calif. 94105.
For address change, include label from recent issue.

SEPTEMBER

COLUMNS

From the Editors 7
by Ken Patrick
Are engineers getting a raw deal?

Business Outlook 41
by Albert F. Duval
Tax reform threatens industry

Career Development 229
by Roberta Bhasin
From lame duck to new guy on the block

Chemical Report 43
by Michael Ducey
Sufur: Prices stable despite market's turmoil

Automation Update 245
by Ole Fadum
Beyond automating your log sheets

Comment 328
by Robert A. Shade
Don't penalize industrial license holders

DEPARTMENTS

Conference Calendar 45
News of People 231
Product Showcase 251
New Products 263
Product Review 283
Literature 287
Bookshelf 303
Safety Notes 305
Finishing/Converting 307
Supplier News 314

SERVICES

Company Index 247
Reader Service Index 248
Reader Service Card 259
Professional Service Directory 316
Classified Advertising 319
Advertisers Index 326

NEWS

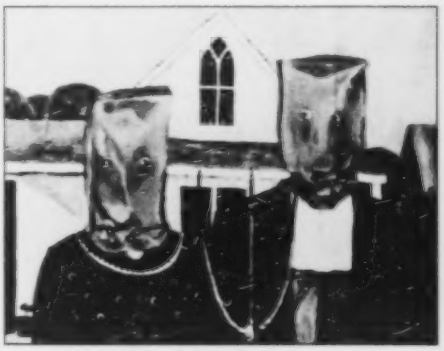
Month in Statistics 9
U.S. paper and paperboard production data for June

Market Report 11
Chaos reigns in prices for linerboard; SBS demand steadies, prices decline; Uncoated's May rise slips somewhat

Grade Profile 13
Uncoated groundwood paper: U.S. mills slump; Canada shows growth

NEWS SCAN

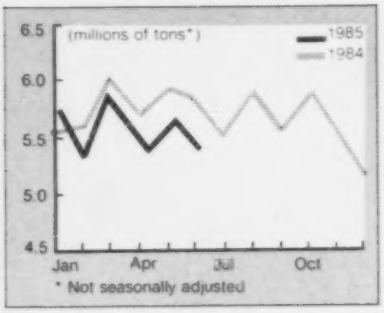
U.S. paper industry profits skid 21
Boise to expand white paper 23
Fibreco Export studies CTMP mill 25
Western Pulp's timely upgrades 25
Gulf Canada to acquire Abitibi 27
Goldsmith wins battle for CZ 27
Waldorf reappears on carton scene 31
Olin sells Ecusta Paper 31
O-I favors new labor contract 31
Japan cutting some tariffs 33
Manville eyes reorganization 35



The many uses of the paper bag 35
P&G sues K-C over diapers 37
Canadian paper demand forecast 37

International News 43
Three new machines start up in Brazil
U.K. firm buys 43% of Portuguese mill
Japanese mills expand coated grades
Specialty paper machine for Germany

U.S. paper and board production



U.S. production of paper and paperboard totaled 5.49 million tons in June, down 5.3% from a year earlier, according to American Paper Institute figures. The seasonally adjusted annual production rate through June stood at 66.6 million tpy, down 2.6% compared with the first half of 1984. Paper production slipped to a rate of 34.0 million tpy, off 1.2% from last year, while paperboard dropped 2.6% to a rate of 32.6 million tpy.

Among major grades, only tissue and uncoated free sheet exceeded year-earlier levels, rising 1.6% and 2.5%, respectively. Groundwood paper, down 8.1%, and packaging papers, down 9.5%, lost the most ground. Production in the strong coated paper segment also lagged year-earlier levels in the first half, falling 2.0% below 1984. Kraft linerboard was down 6.0% compared with last year due to continued sluggishness in export production, which was off 24.5%. Corrugated box shipments fell an adjusted 1.8% from 1984, the Fibre Box Assn. said.

Canadian newsprint shipments declined 7.7% in June, the Canadian Pulp & Paper Assn. reported. Operating rates stood at 89%, compared with 97% in 1984. Canadian pulp shipments lagged last June by 7.1%, with operating rates at 96%. ■

	Latest month (000 short tons)		% change from year ago	Annualized year-to-date (000 short tons)	% change from year ago
PAPER & PAPERBOARD PRODUCTION[1]					
Newsprint	June	449	−4.1	5,483	−2.2
Uncoated groundwood (s)	June	124	−13.3	1,472	−8.1
Coated paper (s)	June	468	−9.7	6,163	−2.0
Uncoated free sheet (s)	June	782	4.3	9,626	2.5
Other printing/writing	June	112	−10.4	1,350	−9.8
Total packaging and other paper (s)	June	418	−11.3	5,224	−9.5
Tissue	June	418	3.0	4,934	1.6
Total paper	**June**	**2,771**	**−3.8**	**34,251**	**−1.9**
Unbleached kraft paperboard	June	1,326	−11.4	16,449	−5.8
Semichemical medium	June	419	−5.4	5,017	−3.5
Bleached paperboard	June	325	−5.2	3,976	−3.0
Recycled paperboard	June	646	−4.0	7,698	−3.7
Total paperboard	**June**	**2,716**	**−8.1**	**33,141**	**−4.6**
Total U.S. paper and paperboard output	**June**	**5,487**	**−6.0**	**67,392**	**−3.3**
PULP, WASTEPAPER & FIBER[2]					
Total U.S. woodpulp production	May	4,532	−5.0	54,546	−2.6
Market pulp production	May	539	−3.9	6,910	1.2
Wastepaper consumption at paper/board mills	May	1,208	−13.0	15,232	−6.7
Pulpwood consumption (cords)	May	7,072	−4.9	87,036	−1.8
CONVERTED PRODUCTS STATISTICS[3]					
Corrugated box shipments (billion ft²)	June	21.245	−5.5	133.413[6]	−1.2
Containerboard inventories at U.S. box plants and mills	June 1	2,922	−2.2		
INTERNATIONAL TRADE[2]					
U.S. paper imports (including products)	May	945	6.2	11,264	12.4
Imports of Canadian newsprint	May	684	11.0	8,244	13.8
U.S. paper exports (including products)	May	297	−29.8	3,913	−10.5
Exports of unbleached kraft linerboard	June	157	−11.8	1,669	−24.5
Exports of woodpulp	May	309	−8.0	3,741	1.5
Norscan pulp inventories[4]	June 30	1,449	−1.2		
Norscan pulp operating rates[4]	June	92%	79%	81%	87%
CANADIAN STATISTICS[5] *(reported in metric tons)*					
Total newsprint shipments	June	733	−16.4	4,485[6]	.9
Operating rates	June	89%	97%	94%	89%
Inventories held by U.S. consumers	June 30	1,463	4.5		
Other paper/board shipments	June	237	4.4	1,493	8.7
Woodpulp shipments (export only)	June	627	−2.2	3,431[6]	8.4
Operating rates	June	96%	99%	89%	82%

1. American Paper Institute. 2. API, Bureau of Census, American Pulpwood Assn. 3. Fiber Box Assn., Paperboard Packaging Council. 4. North American/Scandinavian paper-grade market pulp. 5. Canadian Pulp & Paper Assn. 6. Not annualized. (s) = shipments.

UNCOATED GROUNDWOOD PAPER: U.S. mills slump, Canada shows growth; prices hurt by LWC softness

Grade structure: Physical properties of most uncoated groundwood paper grades are similar to newsprint, with the supercalendering and filler content of the supercalendered (SC) grades being the most notable difference. Newsprint and uncoated groundwood together constitute the low-cost end of the publication paper spectrum. Uncoated groundwood is typically of higher brightness—ranging from 64 to 72 Elrepho compared with 56 to 62 for newsprint—and greater endurance. Major end-uses include Sunday magazines, preprinted inserts, catalogs and other advertising material, directories, and forms. Basis weight range is 20 to 45 lb/3,300 ft².

Production/capacity: U.S. and Canadian production set new records in 1983 and again in 1984, and Canadian output seems likely to reach new levels in 1985 as well. But paper from Canada is taking share from U.S. mills in 1985, and U.S. output is not expected to equal 1984 levels.

Definitions of uncoated groundwood for purposes of industry statistics vary from the U.S. to Canada, and U.S. totals are believed to be more reflective of reality. Indeed, due to the oddities of U.S. tariff nomenclature, which allows Canadian producers to ship such grades as rotonews and some offset paper into the U.S. as standard newsprint, official Canadian estimates of that country's capacity—935,000 metric tons in 1985—are believed to be less than half of Canada's actual capacity.

Tracking capacity both in the U.S. and Canada can also be difficult because many machines can be swung from newsprint to groundwood specialties at will, depending on market conditions. The capacities listed here are those which are believed to be dedicated to uncoated groundwood products other than standard newsprint during 1985.

Outlook: Growth in advertising expenditure slowed down in 1985 after the explosion of the previous two years, and the entire publication papers group reflected that. Several Canadian mills have upgraded newsprint machines to make groundwood specialties in recent years. For that reason—as well as the relatively weak Canadian dollar, permitting Canadian mills to undercut U.S. prices—Canada has gained market share in the U.S. this year. Through May, Canadian shipments to the U.S. were up about 13% while U.S. mills' shipments were down by 7.6%. The overall market this year seems likely to show little growth, if any, due to customer inventory reductions early in the year followed by softness in retail sales and consequent weakness in promotional printing activity.

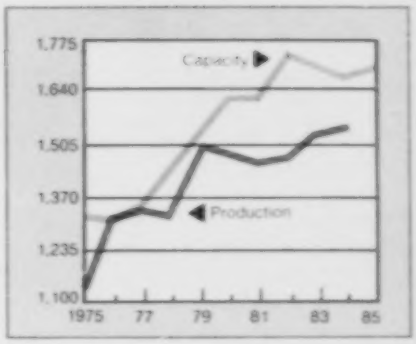
Imports from Europe have gained increasing prominence in North America in recent years. For example, Finnpap is the biggest supplier of SC to the U.S. With the softness in SC this year, import growth should stabilize, although European mills have also been making gains with machine-finished grades.

Pricing: Flat demand in the first half of 1985, loose supply in coated paper, and an ongoing surplus of newsprint produced a weak pricing situation for uncoated groundwood mills by midyear. Prices in 1985 as a whole are expected to do no more than remain level with late 1984.

List prices for some groundwood grades ($/short ton) are: 25-lb roto catalog—1974, $320; 1975, $320; 1976, $345; 1977, $405; 1978, $425; 1979, $468; 1980, $495; 1981, $551; 1982, $551; 1983, $600; 1984, $640; midyear 1985, $680.

30-lb standard rotonews—1978, $345; 1979, $386; 1980, $427; 1981, $490; 1982, $505; 1983, $505; 1984, $515; midyear 1985, $540. ■

SUPPLY/DEMAND (000 tons)



FORECAST (000 tons)

	1983	1984	1985e
Production	1,531	1,565	1,510
Capacity	1,710	1,693	1,710
Utilization rate	89.5%	92.4%	88.3%
Imports	920	1,298	1,360
Exports	37	30	40
Apparent U.S. consumption	2,414	2,833	2,830
lb/capita	20.69	24.06	23.80
GNP ratio	1.57	1.73	1.68

e = P&P estimate
1. American Paper Institute data

TOP U.S. PRODUCERS (000 tpy)

	Annual capacity U.S.	Canada	Total	Market share (%)
1. Abitibi	—	397	397	10.7
2. CIP	—	395	395	10.7
3. MacBlo	—	390	390	10.5
4. GNN	360	—	360	9.7
5. Boise	40	284	324	8.8
6. Champion	286	—	286	7.7
7. Con-Bath	—	285	285	7.7
8. Domtar	—	210	210	5.7
9. Madison	200	—	200	5.4
10. CZ	150	—	150	4.1

Market share of top five companies: **50.4%**

Market share of top ten companies: **81.0%**

Total U.S. capacity (1985): **1.170 million short tons**

Total Candian capacity (1985): **1.991 million short tons**

Total North American capacity (1985): **3.701 million short tons**

SALES/EARNINGS

U.S. paper industry profits skid 19%

U.S. paper industry second-quarter earnings slid 18.9% on a 2.5% rise in sales from their year-earlier level, according to a *Pulp & Paper* survey of results from 33 companies. Of these companies, 21 reported lower earnings, but only one showed a loss.

Flat U.S. industrial activity, the strong dollar, and overcapacity in some grade segments appeared to be the major factors for the decline in net income. Weak prices in the grades most affected by these trends—linerboard, market pulp, and uncoated free sheet—were most often blamed for the lower results.

Nevertheless, companies that were concentrated in the tighter coated paper market or in the consumer-oriented tissue business were able to post gains. Results in wood products were mixed, with some companies reporting higher profits because of improvement in lumber and panel prices and various cost-cutting programs. Most companies predicted that earnings would remain under pressure in the third quarter or through the remainder of the year. But a few chief executives saw some positive signs in the recent decline in interest rates and the drop in the dollar.

Strongest performers. Unaffected by the impact of the strengthening dollar on U.S. industrial activity, most tissue producers posted higher earnings for the second quarter. One notable example is Kimberly-Clark Corp., which racked up a 34% increase in earnings on a 13% increase in sales for the second quarter of 1985, assisted by the strong performance of its diapers business.

Fort Howard Paper Co.—another strong performer—showed a 25% rise in profits on a 4% increase in sales, helped by the weakness in wastepaper prices. Scott Paper Co., on the other hand, reported flat earnings for the second quarter. Poor performance in pulp and forest products pulled down earnings.

James River Corp. reported a 6% increase in earnings, with an improved performance from its tissue operations (earlier hurt by a costly product rollout in the Northeast) offsetting lower profits from uncoated free sheet and pulp. For its entire fiscal year ended Apr. 28, James River posted a 3% increase in earnings on an 8% increase in sales.

Consolidated Papers Inc. was an outstanding performer, producing a 42% jump in profits to reach a new record. Chairman and CEO George Mead attributed the strong performance to recently completed productivity improvement, near-capacity operation, increased tax credits, and price improvements. The company commented that its two lightweight coated groundwood paper mills ran at capacity for the period's duration.

Impact of the dollar. Champion International Corp. reported an 8% increase in second-quarter earnings, "despite strength of the dollar, generally sluggish industrial activity, and increased imports of printing and writing papers." Chairman and CEO Andrew Sigler noted that demand for coated paper has softened due to im-

U.S. paper industry second-quarter results.

Companies	Second quarter ($000) Sales	Change 1985/84	Earnings[1]	Change 1985/84
Boise Cascade	$952,730	−4.6%	$31,680	−5.4%
Bowater Inc.	230,566	−4.5	15,221	−8.0
Champion International[2]	1,598,836	38.8	43,346	8.0
Chesapeake	86,812	2.9	5,402	−11.4
Consolidated Papers	187,187	6.4	29,363	42.1
Crown Zellerbach	769,400	−0.3	21,500	−33.8
Federal Paper Board	191,240	30.8	1,178	−85.7
Fort Howard Paper	373,051	4.4	43,770	25.0
Georgia-Pacific	1,794,000	7.4	67,000*	1.5
P. H. Glatfelter	70,705[3]	−19.7	10,586	0.2
Great Northern Nekoosa	480,600	0.7	12,400	−64.7
Hammermill Paper	437,418	−3.5	10,814	−36.3
International Paper	1,200,000	0.0	35,200	−47.5
James River (4/28)	644,959	−5.2	34,020*	6.2
Jefferson Smurfit	161,146	−8.6	5,589	−7.6
Kimberly-Clark	1,005,100	12.8	78,900	34.0
Longview Fibre (4/30)	109,606	−13.6	4,229	−41.1
Louisiana-Pacific	344,970	6.3	4,970	−33.9
Mead	722,700	−0.5	33,100	−28.2
Mosinee Paper	46,145	−14.4	2,209	−4.2
Pentair	132,985	−7.2	6,534	9.2
Pope & Talbot	85,262	8.8	1,836	−30.1
Potlatch	248,619	−3.9	10,543	−33.8
Scott Paper	761,100	6.9	53,100	0.4
Sonoco Products	23 ,216	21.9	13,599	12.4
Southwest Forest Industries	178,850	−14.7	(2,876) *	n.m.
Stone Container	302,329	−3.7	1,389	−85.3
Temple-Inland	326,500	−0.9	24,200	−16.0
Union Camp	477,605	−5.9	24,715	−51.8
Wausau Paper Mills (5/31)	52,958	−3.9	2,410	13.1
Westvaco	436,226	−2.4	22,952	−18.7
Weyerhaeuser	1,400,117	−4.8	59,683	−42.5
Willamette Industries	304,083	0.0	17,646	5.3
Total	**16,910,083**	**2.5**	**726,208**	**−18.9**

1. Income after taxes from continuing operations, excluding most significant items in both years.
2. Champion results include those of former St. Regis Corp., which was acquired in late 1984.
3. Glatfelter had lower 1985 sales due to sale in Sept. 1984 of West Carrollton, Ohio, mill.

*Boise: includes $17.8 million pretax gain from sale of Newcastle, N.B., mill; Georgia-Pacific: excludes $17 million income from discontinued operations; James River: includes $3.4 million due to actuarial assumptions on pension expense; Southwest Forest: loss includes $1 million pretax gain from sale of lumber unit. n.m. = Not meaningful.

of future claims. The preferred shareholders will receive a new preferred stock, the value of which has yet to be determined.

Manville Corp., parent company of Manville Forest Products Corp., West Monroe, La., had filed for bankruptcy in 1982 after being inundated with claims by those suffering from exposure to asbestos. ■

P&G sues K-C for patent infringement of its diapers

In another effort to protect its Luvs disposable diaper brand, Procter & Gamble Co. has filed a patent infringement lawsuit against Kimberly-Clark Corp. P&G is charging that Kimberly-Clark's use of heat-shrinkable materials to form gathers in its disposable Huggies brand diapers infringes P&G's patent on the material. P&G uses the heat-shrinkable materials to form the waistband in its Luvs diapers.

Procter & Gamble said that Huggies diapers containing the material are being sold in limited markets. It is seeking a court injunction to prohibit further use of the material and is asking for unspecified damages.

• P&G was awarded about $2.4 million in damages earlier this year when a jury found that Weyerhaeuser Co.'s disposable diaper had infringed P&G's patent. ■

FORECAST

Growth ahead for Canadian domestic paper demand

Substantial growth in Canadian domestic consumption of paperboard, newsprint, and printing and writing grades is likely between now and the end of the century, according to a study just published by the Canadian Forestry Service's (CFS) Economics Branch. Growth rates are expected to be stable, continuing the trends of recent years.

That scenario is the result of forecasts which the CFS admits do not consider the possibility of changes in cost relationships, technology, or customer preferences. Thus, CFS has been forced to assume that future growth will represent a continuation of the trends that have occurred in recent years. Models being developed for future forecasts will attempt to include some microeconomic variables.

Even with this limitation, CFS believes its study represents a useful picture of a possible future. It actually presents three scenarios, including a base and pessimistic and optimistic alternatives. In some cases, the CFS analysts believe results may be closer to the extremes rather than to the base.

For example, analysts believe consumption in the year 2000 for building boards may rise only to the low end of the projected range. The pessimistic scenario foresees total growth of only 36.8% from 1984 to 2000, as opposed to the 41.5% growth of the base scenario. Factors cited include the declining proportion of the population in the major home-buying age groups, high interest rates, and competition from synthetic fibers.

Newsprint growth stunted. Newsprint is another area where growth is expected to be "in the lower portion of the projection range." In the pessimistic scenario, Canadian consumption in 2000 for newsprint is forecast at 1.34 million metric tons compared with 1.43 million tons in the optimistic scheme. Factors limiting growth are expected to include competition from electronic media—particularly regarding classified advertising—and demographic trends.

The "culture paper" group, i.e., printing/writing grades and tissue/sanitary products, will see its growth rate fall to a little over half of the nearly 6%/year rate of the 1960-80 period. Elements that will keep demand increasing at a rapid pace include "the increased popularity of magazines and more widespread use of photocopiers."

Factors curbing growth, however, would include the maturation of tissue and sanitary paper markets as new products such as diapers and paper towels are finally absorbed, plus a reduction in the average number of tissue plies due to a shift to air-laid products.

Groundwood paper grades may be subject to increased competition for advertising from electronic media. This—plus the aging of the population—will limit demand growth for groundwood paper.

Canadian domestic consumption forecast for paper and paperboard, CFS base scenario, (000 metric tons).

Product	1990	1995	2000
Paperboard	2,328	2,666	3,007
Wrapping paper	335	331	324
Newsprint	1,109	1,246	1,384
Culture paper[1]	1,896	2,295	2,722
Building boards	432	484	535

1. Printing and writing papers and tissue and sanitary papers.
Source: Canadian Forestry Service, Economics Branch.

Threat from plastic. Technological change is the major factor in continued expected declines in wrapping paper demand. CFS believes plastic displacement of paper bags in the grocery bag market will continue, although demand for shipping sacks will remain strong. The three scenarios for overall wrapping paper consumption converge in 2000 at a level more than 20% below 1974 volumes.

The report also notes that per capita consumption of wrapping paper fell by more than 30% from 1974 to 1981 due to "effective market penetration by the producers of plastic bags and cellophane wrap." CFS believes that a "potential threat exists from low-density polyethelene packaging, which is gaining more consumer acceptance in the U.S. market."

Paperboard, on the other hand, is less susceptible to competition from plastics, and demand is expected to continue rising by 2.3% annually to 2.9% a year through 2000. Milk carton stock was the only area where competition from plastics was mentioned.

The authors seem to feel that all the major groups are either mature or maturing, and thus are more vulnerable to swings in overall economic activity than might have been the case before. Economic growth is expected to "pause" in 1986, 1990, and 1995, slowing growth rates in each group during those years.

To obtain more information about this report—entitled "Canada's Domestic Consumption of Forest Products: 1960-2000," Information Report E-X-35, by Donald Roberts and Dave Luck, contact the Economics Branch of CFS in Ottawa, Ont. ■

SULFUR: Prices stable despite market's turmoil

Consumption. The top purchased chemicals for the sulfite process are sulfur and sulfur dioxide (SO_2). Each pulping operation has either a calcium, magnesium, sodium, or ammonia base depending on the recovery system involved and other factors. Different cooking methods also use caustic, sodium sulfite, and sodium carbonate. There are 35 sulfite pulping operations in Canada and 20 in the U.S. Nearly all of them prepare their cooking sulfur dioxide onsite.

Sulfur is burned at 1,000°C, cooled, and then absorbed in the chosen base. Stored acid is sent through a recovery loop to a high-pressure accumulator where heat, water vapor, and recycled SO_2mix to form the cooking liquor. The total demand for sulfur used by these mills in 1984 was approximately 315,000 metric tons—about 3% of the produced (Frasch and recovered) sulfur in these two countries.

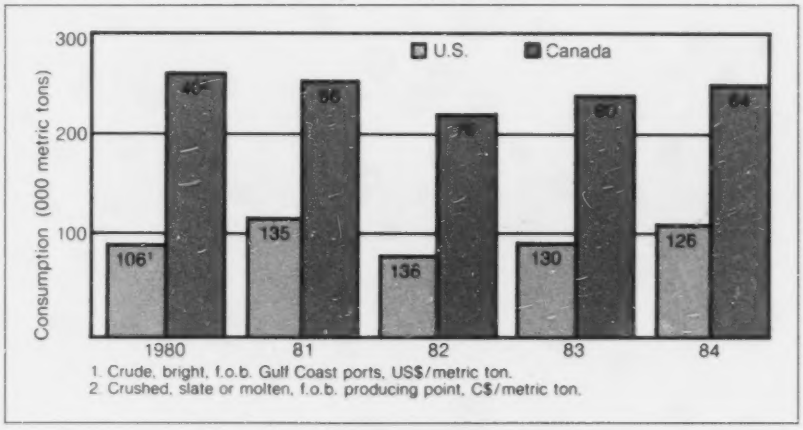
The latest entry into the sulfite pulp market was Crown Zellerbach Corp., which focused its $425-million modernization project in Camas, Wash., around a Kamyr 575-a.d.-tpd continuous digester that uses a magnifite cook. Some speculate that another unit will be sold to a Northeast manufacturer, perhaps by the end of next year.

Several technical developments have influenced sulfite pulping over the last ten years. With the closing of many small mills throughout the 1960s and 1970s (mostly due to uneconomical recovery options), existing mills have introduced modified operations and chemicals to alleviate environmental and competitive disadvantages. Among the more popular applications are high-yield pulping using sodium sulfite and sodium bisulfite, neutral pulping with anthraquinone, or combinations of both.

In addition to the pulping developments, the spent sulfite liquor is currently being examined for use in adhesives and animal feed substitutes and as a dispersant in oil recovery and construction materials preparation.

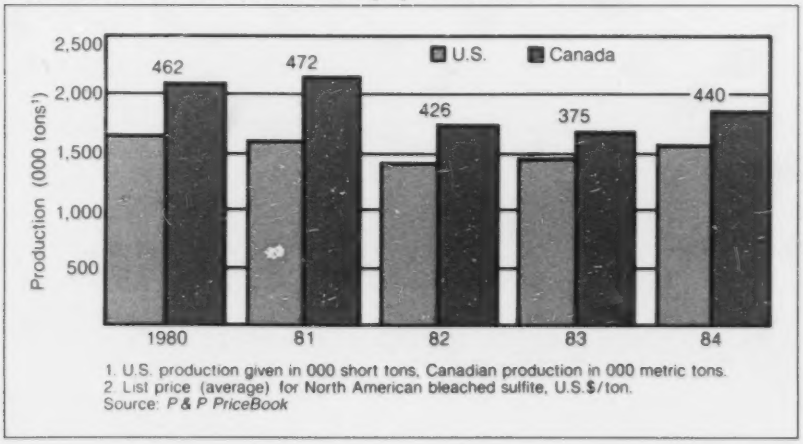
The latest commercial development is alkaline sulfite pulping—a combination of the two major processes. The cooking liquor consists of sodium sulfite and caustic soda in a rapid cook. The resulting pulp exhibits high strength and easy bleachability. Trials have been run on the new pulp in the U.S., and a full-scale plant could be operating in Canada by 1987.

FIGURE 1: **U.S. and Canadian consumption and price of sulfur.**



1. Crude, bright, f.o.b. Gulf Coast ports, US$/metric ton.
2. Crushed, slate or molten, f.o.b. producing point, C$/metric ton.

FIGURE 2: **Production and price of sulfite pulps in the U.S. and Canada.**



1. U.S. production given in 000 short tons, Canadian production in 000 metric tons.
2. List price (average) for North American bleached sulfite, U.S.$/ton.

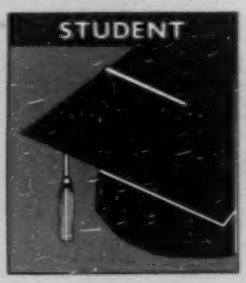
Source: *P & P PriceBook*

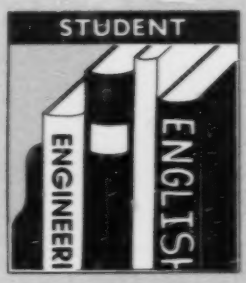
Price. Demand has followed the economic cycles of the industry. Over the first half of this decade, a few developments have changed the nature of the sulfur market. For example, Frasch production declined while recovered sulfur production increased so that each source now supplies about 50% of the market. But production is not expected to grow enough to meet forecast demand.

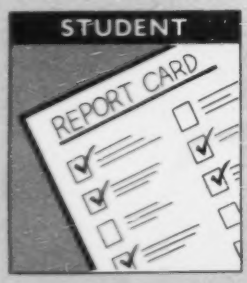
Only three Frasch mines now operate in the U.S., and with oil and natural gas production down, the future of recovered sulfur is in limbo. The Canadian market, once the holder of the world's largest sulfur reserves, now face problems with exhausting its sour gas supply.

U.S. and Canadian producers have maintained price stability over the last 18 months. Most producers have raised prices two or more times during that period, but not without discounting. Prices are currently at $145/metric ton and are headed upward.

Producers are hoping that this price spiral will continue and perhaps surpass 1980's strong prices. ■

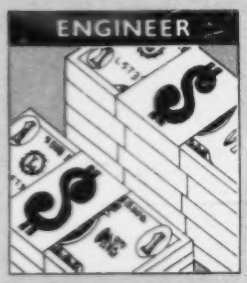


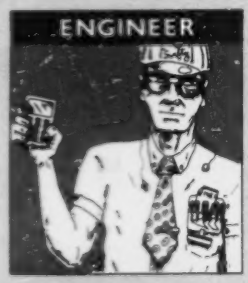


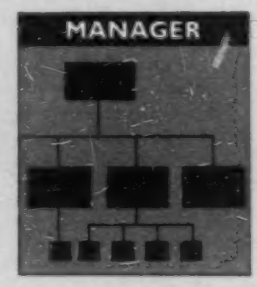


ENGINEERS: *LOSING THE* CAREER GAME?

Today's paper industry provides challenging, practical experience for many young engineers, but those with career ambition take a chance







■ The 13-article examination of engineers in this issue is in four basic parts. The first section takes a look at engineers in the "Student" stage—what today's curricula are like, how they have changed in recent years, and what's on the drawing board for the near future. A survey of graduates from one major paper engineering school rates the value of their education from the perspective of several years' experience in the industry.

Of recent concern in academia is the need for more liberal arts courses vs the push for increased specialization in the engineering disciplines, and this is covered in comments from professors at several major universities offering paper science degrees. Some faculty, students, and practicing engineers themselves feel that the direction of engineering education may remain unsettled even into the next century, as we move through a transition period in technological evolution.

The second section of this special report examines the practicing "Engineer," how he or she is faring as far as salary, promotion, job satisfaction, etc., are concerned, and exactly what the engineering "function" in the paper industry may be. This section also investigates engineers on the move—those caught in the "job-hopping syndrome"—where they are going and why. It includes a humorous view of engineers from the perspectives of various coworkers in the industry, and a comparative analysis of engineering salaries by title, location, years of experience, management level, etc.

The engineer as "Manager" is explored in the third part of this report, which looks at engineers who have made it into management and how they did it. An analysis of who's who in today's paper industry management reflects the success of engineers as they play the career game with many of their nontechnical contemporaries. Some engineer-managers find that they may be slowly losing their engineering credentials as the game progresses. Others, who have advanced to the lofty ranks of upper management as engineers, offer advice to their younger counterparts now entering or already working in the industry.

The engineer-manager section also investigates engineers who may be trapped in the professional "slow lane." What some companies are doing to prevent this is discussed in a report on management development programs currently being used in the paper industry. Completing this section is a psychological analysis of how engineers can overcome some "Achilles' heel" problems they encounter in the management arena.

The engineer who leaves the industry itself and becomes more or less a "Consultant" is considered in the fourth section. These engineers, who are usually highly motivated, career-minded individuals, often "move to the outside" in search of more challenging and creative careers. Why and how some have done this are explored in several articles. Finally, for those contemplating a career change, this section concludes with a review of how to write effective resumes. ■

TABLE OF CONTENTS

STUDENT

56 STUDENTS SPECIALIZE EARLY: Today's pulp and paper schools stress early career focus and boast state-of-the-art facilities

59 HUMANITIES LOSING OUT? Latest debates over pulp and paper curricula pit increased technical training against "traditional" courses

61 REPORT CARD FOR MIAMI U: The curriculum of Miami Univ.'s Pulp & Paper Foundation gets high marks from both students and employers

ENGINEER

81 HOW DOES YOUR SALARY STACK UP? Although paid well, paper industry engineers surveyed report that the top dollar is still to be found in business, management, and sales

86 ENGINEERS SPEAK OUT: Complaining they are stereotyped, engineers are unhappy with image, promotion prospects, salary compression

94 CLIMBING THE CORPORATE LADDER: Career planning programs are available to help engineers map and achieve long-term goals

97 AVOIDING THE DEAD END: Engineers surveyed confirm that job hopping is often the only way to obtain better salaries, mobility

MANAGER

107 THE VOICE OF EXPERIENCE: Six veteran engineers look back on their careers with satisfaction, offer advice to new engineers

111 FORMER ENGINEERS AT TOP: Engineers who made it to corporate level more than likely came up through production or sales

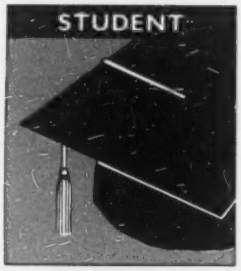
114 PSYCHOLOGICAL PROFILE: Certain personality traits help in the jump from rank and file to management, says psychologist

CONSULTANT

123 WHY CONSULTING? Three former mill-level engineers explain why they left the paper industry to pursue consulting careers

127 FROM SLIDE RULE TO CRT SCREEN: Roles of design and staff engineers will change—not disappear—as computer use increases

130 TIME TO MOVE ON: When changing jobs is the answer, refer to these basics of resume writing



Collect Diploma: Advance Forward

TODAY'S PULP AND PAPER SCHOOLS STRESS HIGH-TECH SPECIALIZATION

By DEBORAH S. SOLLOSI, Staff Editor

Intense specialization coupled with state-of-the-art facilities and practical mill internships prepare today's students for the "real world"

■ We are living in the age of the specialist, and nowhere is this more evident than in pulp and paper science degree programs. Bachelor degree programs in pulp and paper science are characterized by highly specialized curricula and technologically sophisticated learning facilities, which reflect the strong support and influence of the industry as students are trained to meet the needs of today's mills.

Choices are narrowed early in the academic career of those preparing to enter this highly technical industry. Due to a science-oriented, heavily academic schedule, most schools leave little room for humanities courses. Two of the schools *Pulp & Paper* surveyed, Univ. of Maine, Orono, Maine, and Western Michigan Univ., Kalamazoo, Mich., do not even require freshman English. Interestingly, four of the seven schools surveyed do require a class in technical writing.

Curricula tend to emphasize either chemistry or engineering, depending on the university (Table 1), but most indicative of the trend toward specialization is the number of specialized study programs offered within individual pulp and paper departments. For example, Miami Univ., Oxford, Ohio, offers two paper science degree programs. Miami's bachelor of science degree in paper science and engineering includes in its curriculum the requirements for certification as a chemist by the American Chemical Society. Miami's bachelor of science in applied science with a major in paper science and engineering must include study in one of three fields of concentration: (1) paper science, which provides a strong science and engineering background coupled with pulp and paper technology; (2) environmental science, which emphasizes water and air pollution problems and ways in which the paper industry can solve them; and (3) process control, which concentrates on application of computer process control in the paper industry.

Similarly, North Carolina State Univ., Raleigh, N.C., offers a bachelor of science in pulp and paper science with three available courses of study. Western Michigan Univ. offers both a paper science and a paper engineering curriculum, which is further narrowed to a concentration in either manufacturing processes or environmental processes.

All schools surveyed couple their academic schedules with internships at pulp and paper mills, providing students with hands-on work experience. These internships are well-paid, professional-level jobs. Work/study programs and scholarship programs (which are often industry supported) are not uncommon. Both the State Univ. of New York, Syracuse, N.Y., and North Carolina State Univ. report that they are able to offer scholarships to all academically qualified students.

SOPHISTICATED HANDS-ON FACILITIES. Pulp and paper departments sport sophisticated machinery and scientific equipment housed in state-of-the-art facilities. Laboratories and pilot plants allow students to perform engineering calculations on simulated production systems, such as those described below.

• North Carolina State's 20,000-ft² laboratory includes complete facilities for pulp and paper manufacturing: a

TABLE 1: **Credits required for undergraduate degree at institutions offering pulp and paper programs.**

University and degree offered	Biology	Chemistry	Computer science	Economics	Engineering—general	—Chemical	—Electrical	English	Foreign language	History	Humanities	Mathematics	Physical education	Physics	Pulp & paper science	Statistics	Social science	Technical writing	Electives (free)	—Humanities/social sciences	—Technical	Credits required for graduation
Univ. of Maine, Orono Maine B.S., chemical engineering, pulp & paper curriculum	4	23			14	20	3					19	8		18				3	21		133
Miami Univ., Oxford, Ohio B.S., paper science and engineering		39	3	6				6	14			17		13	29	4			3	6		140
B.S., applied science with major in paper science and engineering	3	34	3	6				6				14	6	5	23	4		3	12	6	15[1]	140
North Carolina State Univ., Raleigh, N.C. B.S., pulp and paper science and technology 3 programs offered: (1) Chemical engineering		22				25	3	6				18	4	8	31					18		135
(2) Technology		24			2	7		6				12	4	8	34			3	9	18	6	134
(3) Science		26			2			6				15	4	8	24	3		3	9	18	16	135
Univ. of Wisconsin, Stevens Point, Wis. B.S., paper science		30						6		6		15	4	11	48		9			11		140
Western Michigan Univ., Kalamazoo, Mich. B.S., paper science		34	1								10	20	2	8	48		6	3			4	136
B.S., paper engineering 2 programs offered: (1) Manufacturing processes		11	1		25		8				10	20	2	8	42		6	3				136
(2) Environmental processes	3	18	1		25						10	20	2	8	39		6	3			1	136
State Univ. of New York, Syracuse, N.Y. B.S., paper science and engineering	4	25	3	3	1			6			8	15		8	42				6		9	130
Univ. of Washington, Seattle, Wash. B.S., pulp and paper science		32		5	8	15		5				18		12	43	5		16		21		180[2]

1. To be taken in one of three areas of concentration.
2. Univ. of Washington credits are quarter hours; all other universities listed use semester hours.

scaled-down machine; testing, coating, and environmental laboratories; and modern analytical equipment. More than 20 microcomputers, some of which are connected to mainframe computers, are available for students' use.

• Univ. of Maine has three types of laboratory facilities occupying over 30,000 ft²: basic analytical facilities, a general pilot plant, and specific project units for modern chemical engineering research. In addition, the Pulp & Paper Dept. has a sophisticated computer system, nine CRTs, a plotter, and interfaces for online data acquisition from various research instruments.

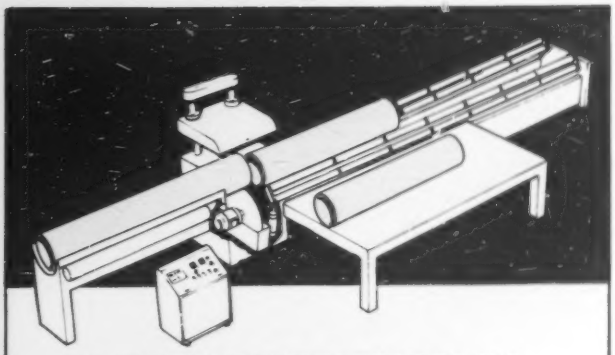
• Univ. of Wisconsin has specialized laboratories, which include microscopy (light and electron), fluid mechanics and hydraulics, physical paper testing, computers and process control, and pulp and paper engineering.

• Western Michigan Univ. maintains a "wet lab" for small-scale paper preparation, a coating lab for coating and sizing paper samples, and a microscopy lab fitted with optical microscopes for fiber identification. Electron microscopes are also available for surface studies. A completely outfitted pilot paper plant and a pilot fiber plant are available for student use.

• State Univ. of New York, College of Environmental Science & Forestry, Syracuse, N.Y., has a pilot plant for instruction and research. The college also has an environmental engineering lab to give students experience in wastewater treatment and wastepaper recycling. A modern chemical engineering lab is used to study all phases of unit operations and processes, process control, and analog simulation.

The list goes on. The universities rely heavily on industry support, often through university foundations, to build, supply, and maintain these facilities. The Syracuse Pulp & Paper Foundation at the State Univ. of New York, College of Environmental Science & Forestry, has taken this relationship one step further to what it terms a "partnership with industry." Member corporations and individuals of the Syracuse Foundation have made possible two major facilities at the college: the pilot plant and the environmental engineering lab. The pilot plant is not only used for student instruction and research, it is also used for pilot projects and tests contracted for by paper industry clients.

Ross S. Whaley, president of the State Univ. of New York, College of Environmental Science & Forestry, commented on the unique relationship his university has with industry: "An understandable industry position might be that education is too important to leave to the schools. But whatever its motives—financial, educational, a need for pioneering research or a desire for well-trained, entry-level personnel—industry has a large stake in the quality and direction of higher education. I think it's safe to forecast that the relationship between industry and higher education will grow even more intimate in the decade ahead, to the direct benefit of both institutions." ■



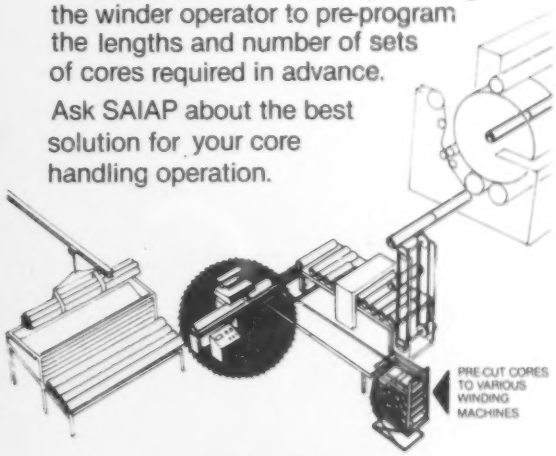
A NEW DIMENSION IN CORE PREPARATION ...FROM SAIAP

SAIAP has produced a system which is helping to optimize the finishing process in mills throughout the world. SAIAP offers a full line of superior core cutting units, from manual feed cutters featuring automatic pre-setting of lengths, to micro-processor controlled systems which can be fitted with:

— automatic notching
— plugging
— metal capping
— polishing features

The micro-processor controlled units' programs can be combined with those of automatic slitter/winders, allowing the winder operator to pre-program the lengths and number of sets of cores required in advance.

Ask SAIAP about the best solution for your core handling operation.

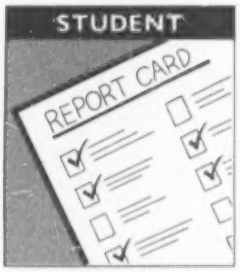


SAIAP

Kjemi Handels AG. Baarerstrasse 8.
CH-6301 Zug. Switzerland. Phone int. 41 42 22 37 17.
Telex 865185 Tfax int 41 42 21 30 92

U.S. Agent: Southeast Engineered Products, Atlanta, GA
Phone (404) 395-6100, Telex 825454

On Reader Service Card **Circle 134**



Alma Mater Makes Grade: Roll Again

MIAMI U CURRICULUM GETS HIGH MARKS FROM ALUMNI, EMPLOYERS

By ROBERT D. FRAIK

But both graduates and employers stress the need for more courses in communication skills, according to two recent Miami Univ. surveys

■ The Academic Committee of the Miami Univ. Pulp & Paper Foundation recently analyzed responses from two surveys conducted to evaluate the Paper Science & Engineering curriculum. The responses from 242 alumni and 74 industry employers to surveys designed for each group gave the committee the objective criteria for evaluation. Survey results are being published because they cover topics of general interest as well as those specific to the curriculum.

In the first survey, Miami Univ. Paper Science graduates were asked to gauge how well the school prepared them for their careers. Both technical and nontechnical courses were evaluated on their relevance and importance to the development of the graduate's overall career path.

The second survey was designed to determine future demand for graduates and the skills paper manufacturers and allied companies deemed important when hiring graduates.

GOOD SURVEY PARTICIPATION. Miami Univ. first offered the Paper Science & Engineering curriculum in 1957. Since the curriculum's inception, 485 undergraduate and 49 graduate degrees have been awarded. All graduates of the curriculum with known addresses were surveyed.

Mr. Fraik is manager, quality assurance and product development, Beckett Paper Co., Hamilton, Ohio. He was chairman of the Academic Committee of the Miami Univ. Pulp & Paper Foundation, which conducted the surveys discussed in this article. Other committee members were George Alderfer, James River Corp.; Roger Bart, Union Camp Corp.; Roger Kilburn, Ralston Purina Co.; David Ormerod, Calgon Corp.; James V. Robinson, Mead Corp. (retired); William Scott, Miami Univ. (department chairman); Edward Strazdins, American Cyanamid Co.; and Allen Springer, Miami Univ.

TABLE 1: **Years since graduation (alumni response).**

Years since graduation	Percent
1–5	46
6–9	22
10–13	15
14–17	10
18–22	7
Total	**100%**

Mean years since graduation: 8

TABLE 2: **Graduate school attendance (alumni response).**

Attendance at graduate school	Percent
Science/engineering	5
Business administration	20
Pulp & paper science	18
Other	3
No graduate school	54
Total	**100%**

TABLE 3: **Anticipated demand for graduates, (employer response).**

Employment group	Percent of total response	Greater demand (%)	Same demand (%)	Less demand (%)
Paper manufacturers	41.6	24	76	0
Chemical suppliers	31.7	37	58	5
Equipment manufacturers	23.3	50	41	9
Construction & engineering	3.4	50	50	0
Weighted average	—	**35**	**61**	**4**

The employer survey was sent to 200 executives employed by paper manufacturing companies and companies allied to the paper industry. The mailing list included all corporate members of the Miami Univ. Pulp & Paper Foundation and corporate members of the Technical Assn. of the Pulp & Paper Industry (TAPPI).

A total of 242 alumni responded to the survey, or 54% of those surveyed. The average time elapsed since graduation for respondents was six years (Table 1). While the relative inexperience of the respondents made it difficult to detect trends, it did provide feedback on the curriculum changes made in recent years.

Forty-six percent of alumni respondents had attended graduate school. Business administration and pulp and paper science graduate schools were selected by 79% of those students attending graduate school as shown in Table 2.

Seventy-four employers (37%) responded to the survey. Employer response included 42% from paper manufacturing companies, 32% from chemical suppliers, 23% from equipment suppliers, and 3% from construction and engineering firms.

EMPLOYMENT TRENDS AND DEMAND. An increase in demand for pulp and paper science graduates was indicated by all groups of employers surveyed. Employer response indicated those companies allied to paper manufacturers may provide more employment opportunity for graduates than in the past (Table 3). When compared with the history of alumni employment (Table 4), an increase in graduate recruitment by the allied companies could indicate a trend. The allied companies may be "growing their own" experienced technical personnel rather than hiring experienced graduates from paper manufacturing firms.

There also appears to be a trend to leave the paper and allied companies. An option entitled "other" was included for response on company classifications not listed. Respondents using the "other" category were mainly employed outside the industry. While 6% of alumni surveyed started in positions outside the industry, 10% are currently working outside the industry (Table 4).

Process engineering, technical sales and service, and research positions represented more than 80% of start-

TABLE 6: **Relevance and importance of courses offered (alumni response).**

Course	Number of semester credit hours	Percent response High	Average	Low	Course	Number of semester credit hours	Percent response High	Average	Low
Freshman year					**Sophomore year**				
General Chemistry	10	71.2	26.3	2.5	Organic Chemistry	10	53.1	38.7	8.2
Comp. & Literature	6	43.0	39.8	17.2	Engineering Statistics	4	64.7	31.6	3.7
Calculus	10	31.4	51.1	17.5	Differential Equations	4	16.2	50.9	32.9
Intro. to Paper Science	2	67.2	28.6	4.2	Principles of Economics	3	31.5	51.5	17.0
Paper Testing	2	64.6	31.3	4.1	Papermaking	4	76.7	21.2	2.1
Intro. to Data Analysis	2	73.9	25.1	1.0	FORTRAN Programming	3	49.2	38.9	11.9
Paper Properties	2	68.5	29.1	2.4	Environmental Science	3	29.7	54.6	15.7
Junior year					**Senior year**				
Quantitative Analysis	4	35.3	48.6	16.1	Heat Transfer	3	59.2	37.0	3.8
Material & Energy Balance	3	74.6	24.4	1.0	Mass Transfer	3	59.5	36.6	3.9
Fluid Mechanics	3	58.9	35.7	5.4	Physical Chemistry	6	25.2	47.4	27.4
Physics	8	27.8	54.6	17.6	Wood Chemistry	3	42.4	49.5	8.1
Pulping	5	75.7	21.6	2.7	Technical Writing	3	79.9	16.8	3.3
Fiber Microscopy	1	22.2	54.0	23.8	Paper Physics	3	46.0	46.0	8.0
Engineering Economics	3	51.7	44.2	4.1					

TABLE 4: **Alumni employment by company type.**

Type of company	Initial position (%)	Current position (%)
Sales/marketing	1	4
Pulp/paper	69	57
Chemical	10	15
Equipment	7	8
Converting	5	4
Engineering	2	2
Other	6	10
Total	**100**	**100**

TABLE 5: **Alumni employment by position.**

Position	Initial (%)	Current (%)
Process engineer	44	21
Product development	6	7
Technical sales/service	22	19
Production	3	13
Research	16	12
General management	0	8
Other	9	20
Total	**100**	**100**

ing positions for alumni (Table 5). Moving from process engineering to production and general management was the major change between the alumni's starting and current positions.

RESPONSE ON CURRICULUM. Alumni feedback on curriculum was solicited in two ways. First, each alumnus was asked to rate each course of the current four-year curriculum for relevance and importance. A high, average, and low rating scale was used (Table 6). Since courses have been added and dropped over the years, most respondents were not able to evaluate all courses covered.

To rank the importance of alumni response for all courses, the percentage of low response was subtracted from the percentage of high response to determine the net response for each course. Average responses were considered neutral and were not used. The ranking of the 27 courses is shown in Table 7.

Write-in comments was the other method of alumni input. Comments on courses were grouped by course and topic. While many of the comments were unique to the respondent, the 12 topics most often mentioned are listed in Table 8. In all cases, the alumni suggested increased emphasis on the topic mentioned.

The employer survey rated desired skills and courses intended to develop skills. It also had a write-in response. Table 9 shows the results from the multiple-choice and write-in response of the employer survey.

The strong socially oriented response to the technically oriented surveys is significant. The ability to communicate effectively was given top priority by both alumni and employers. The numerous comments encouraging improved "people skills" were made even though the university requirements have included six credit hours of humanities and six hours of social science since the inception of the Paper Science & Engineering curriculum.

In view of the results and the ongoing debate on liberal vs specific curricula, it is unfortunate the liberal courses were not included in the surveys. While the responses suggest more emphasis on liberal courses, a change in the nature of the liberal courses may be indicated. This is one explanation for the number one rank

TABLE 7: **Course rating by alumni.**

Rank	Course title	High − low (%)
1	Technical Writing	76.3
2	Papermaking	75.1
3	Material & Energy Balance	73.6
4	Pulping	73.0
5	Data Analysis	72.9
6	General Chemistry	68.7
7	Paper Properties	66.1
8	Paper Science	63.0
9	Engineering Statistics	61.0
10	Paper Testing	60.5
11	Mass Transfer	55.6
12	Heat Transfer	55.4
13	Fluid Mechanics	53.5
14	Engineering Economics	47.6
15	Organic Chemistry	44.9
16	Paper Physics	38.0
17	Fortran	37.3
18	Wood Chemistry	34.3
19	Composition & Literature	25.8
20	Quantitative Analysis	19.2
21	Principles of Economics	14.5
22	Calculus	13.9
23	Environment	13.3
24	Physics	10.2
25	Fiber Microscopy	−1.6
26	Physical Chemistry	−2.2
27	Differential Equations	−16.7

TABLE 8: **Alumni write-in comments.**

Rank	Topic	Number of comments
1	Computer Programming (replace FORTRAN with BASIC)	42
2	Technical Communications & Behavioral Science	34
3	Process Control & Simulation	29
4	Basic Engineering	25
5	Business Marketing	22
6	Papermaking & Equipment (practical, hands-on)	18
7	Pulping, Bleaching, Recovery, Power	17
8	Management	15
9	Statistics	14
10	Co-op & summer experience	14
11	Cylinder Machinery, Secondary Fiber	9
12	Coatings, Converting, Printing	9

of Technical Writing while Composition & Literature is far down the list on the alumni survey. Another interpretation is that training to develop the "language of technology" may not be compatible with the language taught in liberal courses.

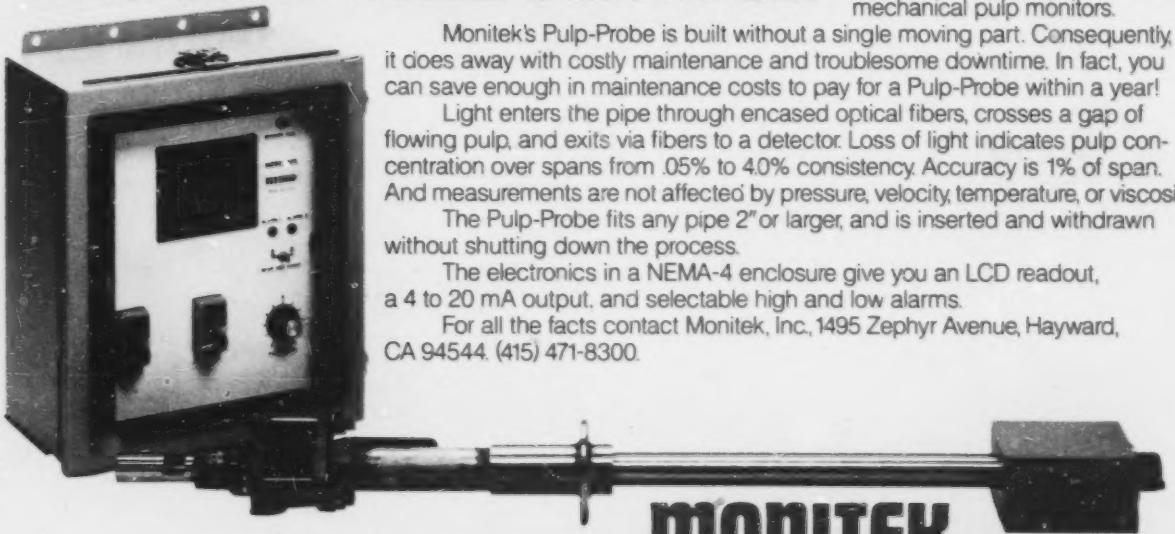
The high level of participation from alumni indicated that they appreciated the opportunity to comment on their education. This approach should be considered by other academic institutions when evaluating their own programs. ■

TABLE 9: **Relative importance of course content (employer response).**

Rating	Multiple choice response	Write-in response
Most essential	1. Written communication skills	1. Report writing
	2. Oral communication skills	2. Presentations
Essential	3. Basic Engineering	3. Computer skills
	4. Basic Papermaking	4. Business & Management
	5. Chemical Engineering	5. Marketing
Desired	6. Computer skills	—
	7. Basic Pulping	—
	8. Process Control	—
	9. Business skills	—
Less important	10. Summer work experience	—
	11. Environmental & Energy Science	—
	12. Co-op experience	—
	13. Statistics	—
	14. Advanced Papermaking	—
	15. Advanced Pulping	—
	16. Basic Converting	—

MONITOR PULP WITH A LIGHT IN THE PIPE. NO MOVING PARTS. AND TROUBLE-FREE SERVICE.

Now a simple stainless steel rod enclosing light-guiding optical fibers can replace those awkward mechanical pulp monitors.



Monitek's Pulp-Probe is built without a single moving part. Consequently, it does away with costly maintenance and troublesome downtime. In fact, you can save enough in maintenance costs to pay for a Pulp-Probe within a year!

Light enters the pipe through encased optical fibers, crosses a gap of flowing pulp, and exits via fibers to a detector. Loss of light indicates pulp concentration over spans from .05% to 4.0% consistency. Accuracy is 1% of span. And measurements are not affected by pressure, velocity, temperature, or viscosity.

The Pulp-Probe fits any pipe 2" or larger, and is inserted and withdrawn without shutting down the process.

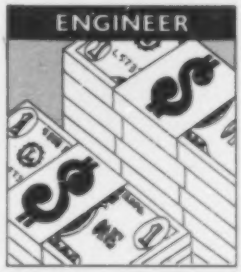
The electronics in a NEMA-4 enclosure give you an LCD readout, a 4 to 20 mA output, and selectable high and low alarms.

For all the facts contact Monitek, Inc., 1495 Zephyr Avenue, Hayward, CA 94544. (415) 471-8300.

MONITEK

LIQUID MONITORING SPECIALISTS

On Reader Service Card **Circle 135**



Move Up: Collect Bonus

HIGHEST PAID ENGINEERS FOUND IN MANAGEMENT AND MARKETING

By KENNETH E. SMITH, Executive Editor

Paper industry engineers were paid a median salary of $40,000 last year—fourth highest of top 16 industries; top pay went to supervisory levels

■ Engineers who want to earn the highest salaries will have to go into management, business, or sales. This is the conclusion of every recent survey of engineers working in the U.S. The survey conducted last year by the Engineering Manpower Commission (EMC) of the American Assn. of Engineering Societies showed that engineers in the paper industry were paid a median salary of $40,000. This figure compared very favorably with 16 other major industries. Paper industry engineers ranked fourth overall in the survey. Nonsupervisory engineers were paid an average median salary of only $33,000, however, while supervisory engineers earned an average median salary of $43,100 (Figure 1).

Pulp & Paper's 1984 survey of its readers showed a better weighted average median salary of $44,000 for readers with bachelor's degrees in the six engineering disciplines highlighted in Table 1. Readers with bachelor's degrees in business ($49,000) and liberal arts ($50,000), however, did considerably better—presumably because they are working in upper management or sales and marketing. In fact, P&P's survey (Table 2) showed that respondents who reported their principal job function as administration had the highest median salary ($58,000).

Other high-paying job functions were consulting ($50,000), and sales and marketing ($49,000). Engineers actually practicing basic engineering in the industry, i.e., those listing engineering design and engineering/maintenance as principal job functions, reported median salaries lower than the average at $43,000 and $40,000, respectively. Table 3 confirms the relationship between increased supervisory responsibility and better pay.

NSPE SURVEY RESULTS. The National Society of Professional Engineers' (NSPE) 1984 survey of its 62,371

FIGURE 1: **Engineering Manpower Commission's comparison of engineers' median salaries in the paper industry.**

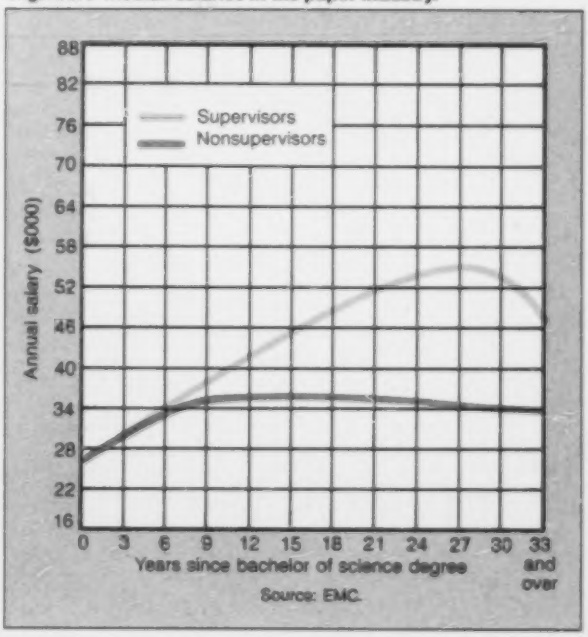


TABLE 1: **Income and educational field—bachelor's degree only—all respondents to *P&P* survey.**

Discipline	Income ($1,000) Lower decile	Lower quartile	Median	Upper quartile	Upper decile	Percent change in median 1983-84	Percent response
Forestry/agriculture	30	39	49	65	83	22	3.5
Chemistry	33	38	48	56	68	20	9.8
Mechanical engineering	32	35	44	56	68	2	16.7
Chemical engineering	31	36	48	58	73	0	14.4
Civil engineering	34	36	45	55	64	12	4.2
Electrical engineering	32	37	48	54	63	11	5.4
Industrial engineering	29	37	44	56	82	7	2.3
Mathematics/physics	33	37	46	55	75	15	1.5
Computer science	25	25	25	25	25	−40	0.1
Biology/life science	27	29	35	42	53	2	2.0
Paper science & technology	29	33	41	51	65	7	13.1
Environmental science	29	35	38	46	51	−9	1.0
Business	31	37	49	59	78	13	18.1
Liberal arts	29	37	50	63	72	2	2.8
Other	30	34	44	58	80	−2	5.1

members yielded similar findings. The median annual income (salary, fees, cash bonuses, and commissions) of survey participants was $43,017. According to the NSPE (Figure 2), engineers in executive and administrative positions were the highest-paid respondents with a median annual salary of $51,000, followed by those in sales and marketing ($43,484), and R&D ($43,000). Engineers working in the design field, those in construction supervision, and those in production, quality control, maintenance, etc., fared least well ($37,500, $38,000, and $38,185, respectively). Teaching/training and project study and analysis fell in the middle ($40,100 and $39,800, respectively).

Engineers employed by petroleum and coal product producers had a median income of $50,675—the highest of the 25 groups reported (Figure 3). This group was followed by those employed by pipeline utilities ($47,950). Communication services and chemical, pharmaceutical, and allied products manufacturers—pulp and paper falls into the latter category—came in next at $47,000. The lowest median incomes were received by employees of state and local governments and the federal gov-

TABLE 2: **Income and principal work function, all respondents to *P&P* survey.**

Principal function	Income ($1,000) Lower decile	Lower quartile	Median	Upper quartile	Upper decile	Percent change in median 1983-84	Percent response
Administration	34	46	58	82	122	18	10.2
Research & development	31	37	45	55	68	9	9.2
Consulting	28	36	50	60	70	6	3.8
Engineering design	30	35	43	53	64	4	14.4
Teaching/academic	39	39	39	39	39	29	0.1
Product development	28	31	38	54	57	−4	1.8
Production & mill/plant operation	33	36	45	55	71	4	17.0
Engineering/maintenance	31	35	40	48	60	2	10.3
Sales and marketing	30	38	49	58	75	2	10.5
Technical service/quality control	29	33	39	46	54	8	14.2
Other	27	33	40	58	72	−2	8.5

TABLE 3: **Income and level of supervisory responsibility, all respondents to *P&P* survey.**

	Income ($1,000)						
Supervisory responsibility	**Lower decile**	**Lower quartile**	**Median**	**Upper quartile**	**Upper decile**	**Percent change in median 1983-84**	**Percent response**
None	27	30	36	44	50	9	12.0
Indirect or staff	29	33	39	47	56	5	23.0
Team or unit	30	35	42	50	56	7	14.9
Project or section	32	36	45	54	60	7	18.9
Major department or division management	35	45	54	68	83	7	25.5
Corporate management of organization	38	51	70	104	150	9	5.6

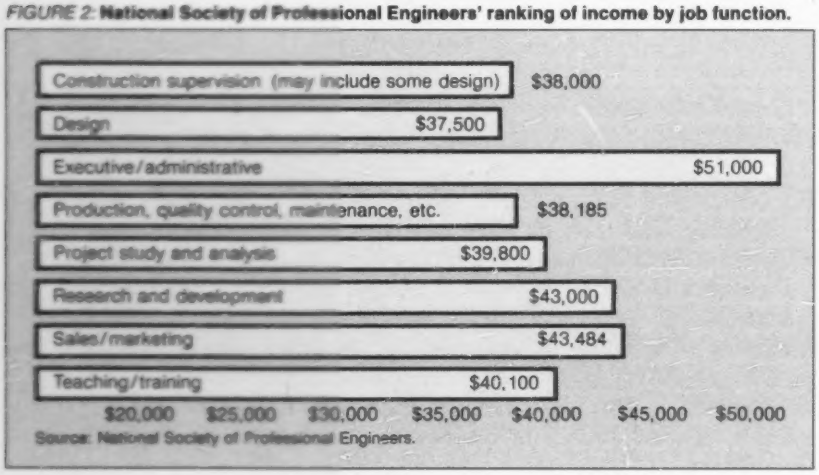
ernment ($37,000, $37,681, and $40,869, respectively). Engineers employed by manufacturers of fabricated metal products and transportation equipment also fared poorly ($41,000 and $41,211, respectively).

The NSPE survey found that supervisory/managerial responsibility plays a major role in determining income (Figure 4). For example, respondents in nonsupervisory positions had a median income of $36,895, while those who supervised one or two engineers, scientists, and/or technologists received $38,000. The median income for those respondents who directed the activities of 50 or more such professionals ranged from $38,000 to $64,500.

The income of respondents with supervisory or managerial responsibility over clerical, construction, maintenance, and/or production employees rose rapidly from $34,895 for those who supervised three to nine subordinates to $69,000 for those who directed 500 or more such employees.

MORE RESPONSIBILITY, MORE PAY. It is significant that the *Pulp & Paper*, EMC, and NSPE surveys all found that job function and supervisory responsibility—along

FIGURE 2: **National Society of Professional Engineers' ranking of income by job function.**



Source: National Society of Professional Engineers.

TABLE 4: **Bureau of Labor Statistics comparison of top earning professions.**

Occupation	Number surveyed	Median ($) Salary	Median ($) Standard error	Mean ($) Salary	Mean ($) Standard error
Engineers					
Aerospace	74	36,392	1,206	34,956	1,102
Petroleum	31	35,197	4,363	37,452	1,710
Chemical	56	33,905	2,152	35,209	1,307
Nuclear	17	47,507	2,692	43,950	1,939
Electrical & electronic	469	33,972	548	34,188	456
Marine & naval architects	20	42,031	4,382	40,532	2,396
Scientists					
Physicists & astronomers	29	36,615	4,373	34,905	2,129
Geologists & geodesists	42	41,777	4,752	38,654	1,896
Physical, other	12	36,195	4,007	34,797	2,735
Legal					
Lawyers	308	35,110	1,405	35,365	714
Judges	25	48,630	5,028	40,556	2,626

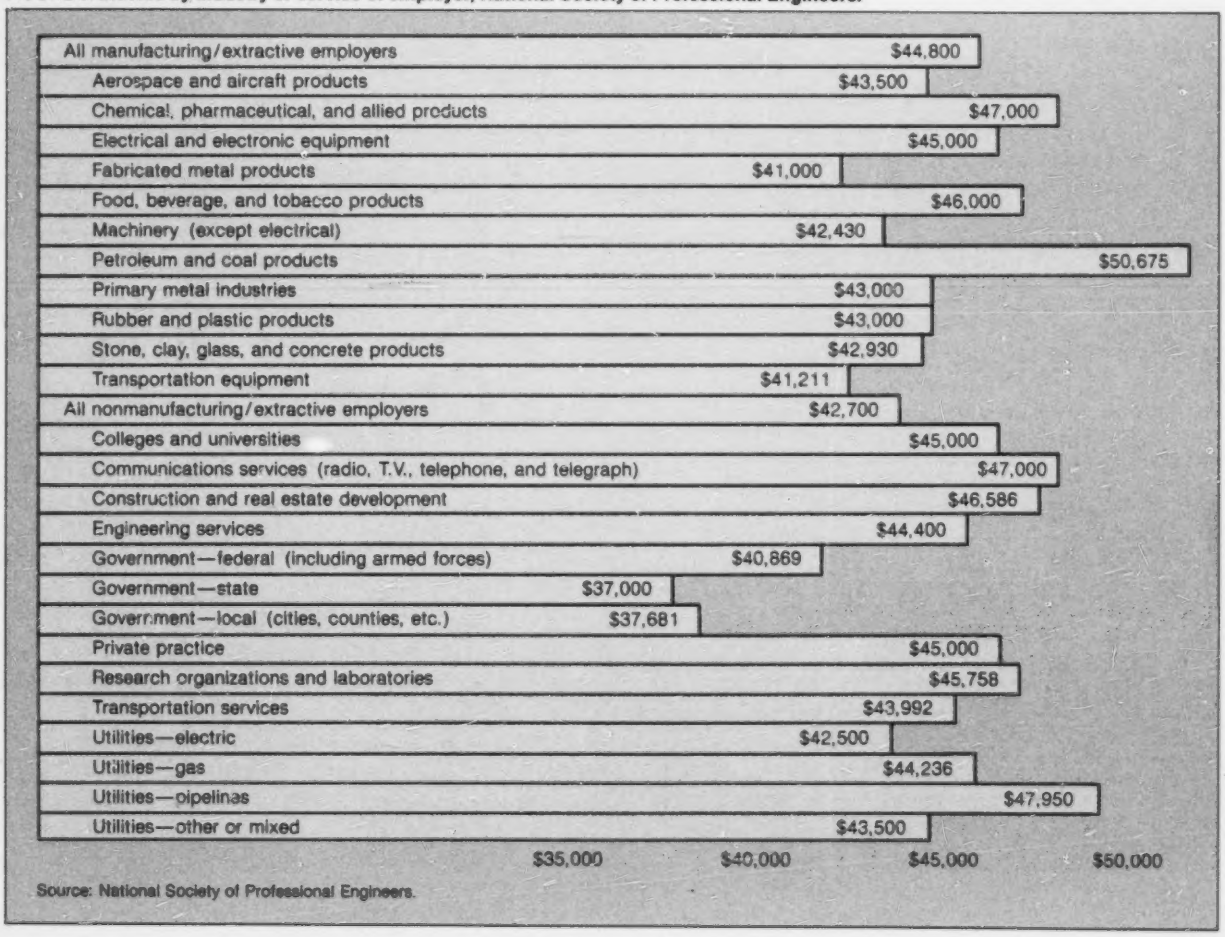
Source: Bureau of Labor Statistics.

with experience—were the determining factors in salary level. Other factors such as geographic and size of the employing organization were not nearly as significant.

For many engineers, gaining increased responsibility often means moving away from practicing engineering in the traditional sense. (*Editor's note:* The merits and problems of such moves are discussed in detail in other articles in this special issue.) However, this does not mean that career engineers will not earn a good living compared with other professionals. The U.S. Bureau of Labor Statistics (BLS) has collected data on weekly earnings by demographic group since 1979. Table 4 presents the annual earnings of the 11 top-salaried groups surveyed in 1984. The figures are based on averages of the weekly earnings of full-time employed wage and salaried workers.

The BLS survey also divides engineers into eight work-level categories according to a combination of factors, including technical complexity of work, level of re-

FIGURE 3: **Income by industry or service of employer, National Society of Professional Engineers.**



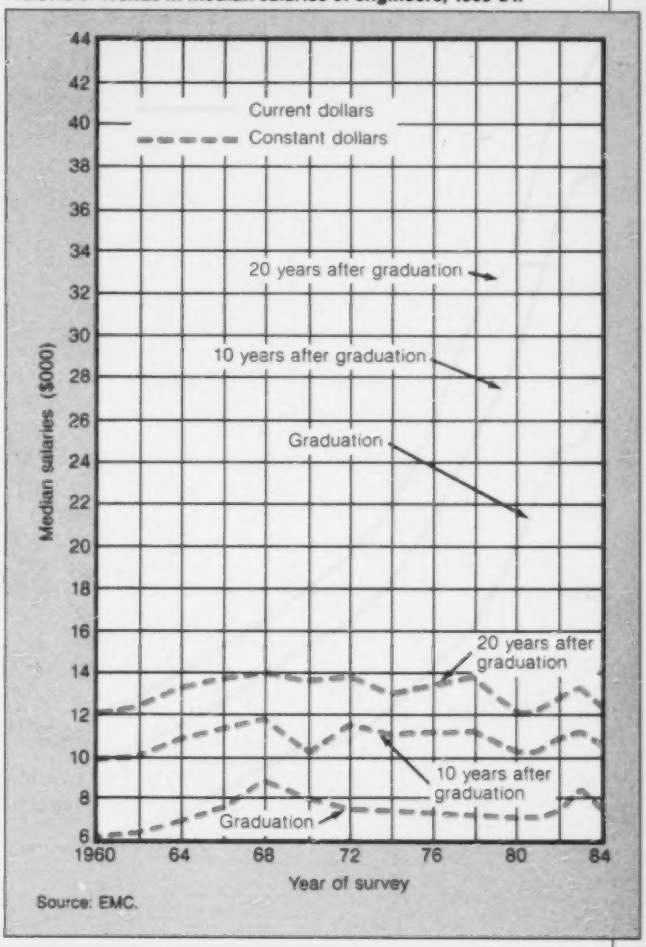
Source: National Society of Professional Engineers.

sponsibility, and scope of authority. Salary is matched with the level of responsibility in a progression of steps headed by Level 8 engineers in 1984 at an average salary of $70,788. Usually a Level 8 engineer is a company's top engineer with full responsibility over a broad, highly complex, and diversified engineering program. The top engineer directs several high-level subordinates, each of whom directs large, important segments of the engineering program.

Average salaries in other BLS categories were $28,899 for Level 2, $32,761 for Level 3, $39,005 for Level 4, $46,349 for Level 5, $53,749 for Level 6, and $61,166 for Level 7. According to the BLS, the greatest number of engineers are in Level 4, which is structured to include "professionals who are fully competent in all technical aspects of their assignments, work with considerable independence, and, in some cases, supervise a few professional and technical workers."

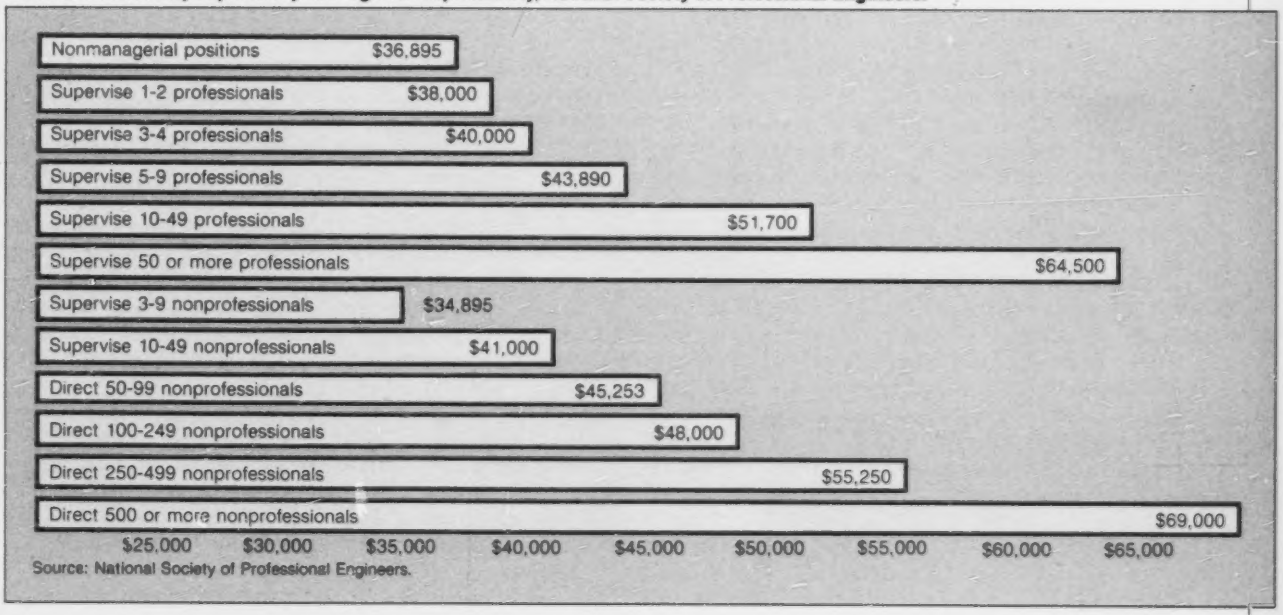
Thus, the majority of engineers, with or without supervisory responsibility, earn a salary that compares favorably with several other respected professions. All engineers, however, have to be concerned with whether their salaries have kept pace and will continue to keep pace with the cost of living. Figure 5, from the EMC survey, shows that salary increases for engineers during the past 24 years have not translated into increased buying power. Thus, it seems likely that engineers will continue to seek advancement and increased responsibility because of the compensation that goes with it. For most of them, this will mean moving away from "traditional" engineering. ■

FIGURE 5: **Trends in median salaries of engineers, 1960-84.**

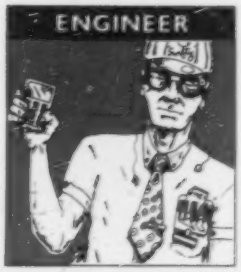


Source: EMC.

FIGURE 4: **Income by supervisory/managerial responsibility, National Society of Professional Engineers.**



Source: National Society of Professional Engineers.



Caught with Pocket Protector: Skip a Turn

PAPER INDUSTRY ENGINEERS NOT HAPPY WITH IMAGE OR PROSPECTS

By MATTHEW J. COLEMAN, Engineering Editor

"We're tired of being stereotyped," engineers complain. They are also dissatisfied with their prospects for promotion and salary compression

■ Engineers in the paper industry is the focus of *Pulp & Paper*'s bimonthly *Engineer to Engineer* column. This column provides a forum for engineers to express their opinions on subjects of interest and gather feedback. Engineers, like all professionals, have concerns about jobs and careers, including concerns about image, salary, promotions, professional standing, and access to modern technology. The following profile of engineers taken from *Engineer to Engineer* columns has been assembled to give a better idea of what is important to engineers in the pulp and paper industry. Specifically, this article covers image, promotions, and salaries.

ENGINEERS ON DISPLAY. Engineers in the paper industry resent being stereotyped. They don't like being portrayed as somewhat eccentric, strangely dressed slide rule jockeys, good at numbers but not necessarily good at the English language. Most take their jobs seriously and feel they play a vital role in keeping the industry progressive and efficient.

Typically, engineers see themselves as conservative individuals who are logical, analytical, practical, factual, creative, and oriented toward math and computers. They believe that engineers have a well-rounded education, understand the business side of industry, work well with people, and have management potential. But nonengineering employees don't agree with many of these perceptions.

Basically, these are the results of an engineer profile survey that ran in the May 1984 *Engineer to Engineer* column (*P&P*, May 1984, p. 159). The first part of the quiz was actually conceived as a tongue-in-cheek look at engineers, but several questions obviously touched on subjects of general concern to most respondents.

Engineers and nonengineers generally agreed on many of the typical engineer characteristics, but engineers seem to be unaware of some impressions they give to nonengineers. How these impressions are formed is beyond the scope of this article, but responses to several questions possibly provide an indication.

For example, the statement that engineers are condescending to nontechnical people drew a 69% negative response from engineers, but 58% of the nontechnical employees felt it was true.

Engineering and nonengineering types may also have differing views on what is important to the successful operation of a business or industry: the knowledge and training that comes with taking "harder" technical courses in college or the advantages of more subjective, but critical "arts" such as communications. We can assume that nonengineers consider good communication skills important in their businesses, and 67% thought engineers were deficient in this regard. Engineers (71%) disagreed.

The fact that nonengineers also disagreed overwhelmingly with engineers on the questions of well-rounded education, understanding the business side of things, being creative, and working well with people further indicates that engineers may not be fully attuned to the impressions they make on their nontechnical peers.

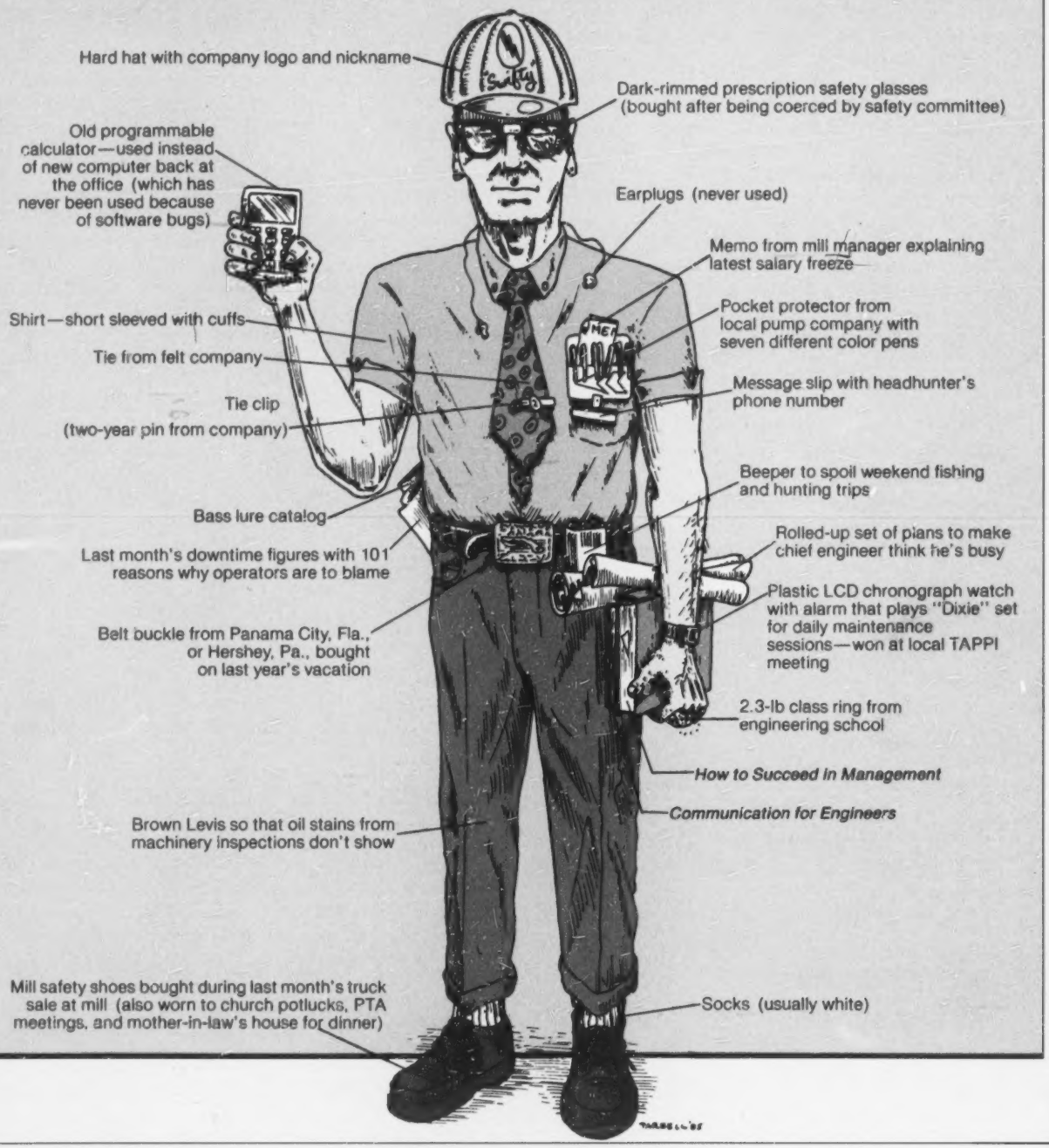
Most respondents gave straightforward answers to

DOES THE STEEL-TOED SHOE FIT?

Can an engineer be spotted in a crowd? Is there something about the way they dress, how they walk and talk? Do they behave strangely, think differently, have funny ways of doing things? Not really.

At least engineers themselves don't think so, and, in general, most people agree, as *Pulp & Paper* surveys have shown during the past year or so. But some nontechnical coworkers do see a stereotypical engineer—one who they could pick out in a crowd, one who simply by "image" alone would be called an "engineer."

For fun, the following composite sketch reflects some of these stereotypical perceptions, but obviously this is not intended to be a serious depiction of an engineer. Like all people, engineers cannot be so easily categorized.


Hard hat with company logo and nickname
Dark-rimmed prescription safety glasses (bought after being coerced by safety committee)
Old programmable calculator—used instead of new computer back at the office (which has never been used because of software bugs)
Earplugs (never used)
Memo from mill manager explaining latest salary freeze
Shirt—short sleeved with cuffs
Pocket protector from local pump company with seven different color pens
Tie from felt company
Message slip with headhunter's phone number
Tie clip (two-year pin from company)
Beeper to spoil weekend fishing and hunting trips
Bass lure catalog
Rolled-up set of plans to make chief engineer think he's busy
Last month's downtime figures with 101 reasons why operators are to blame
Plastic LCD chronograph watch with alarm that plays "Dixie" set for daily maintenance sessions—won at local TAPPI meeting
Belt buckle from Panama City, Fla., or Hershey, Pa., bought on last year's vacation
2.3-lb class ring from engineering school
How to Succeed in Management
Communication for Engineers
Brown Levis so that oil stains from machinery inspections don't show
Mill safety shoes bought during last month's truck sale at mill (also worn to church potlucks, PTA meetings, and mother-in-law's house for dinner)
Socks (usually white)

questions on the personal eccentricities of engineers. Reported observations by many people, however, (including this editor) are that at least around some offices, pocket protectors, white socks with black shoes, and other forms of personal expression appear more often than is acknowledged. Some respondents caught the lighter side of these questions, but a few were upset. However, nonengineers do notice these characteristics.

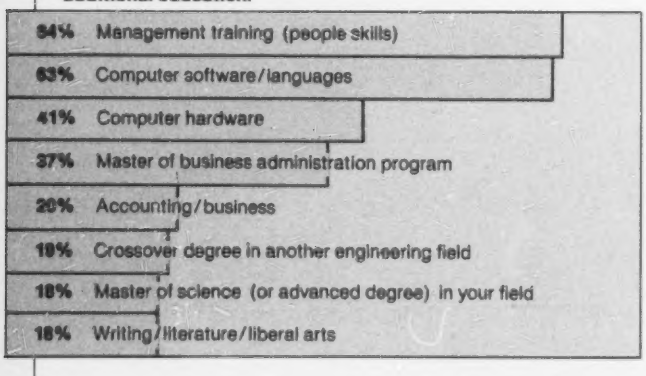
Figure 1 shows engineers' interest in additional education. Continuing education that can be of immediate benefit (computer training, management development) ranked the highest. Surprisingly, there was an equal amount of interest in pursuing a master of science degree as there was in getting a liberal arts, crossover bachelor of science, or accounting degree. The need for specialty programmers familiar with the papermaking process is increasing in the paper industry; thus, the software category received a high response. Most engineers are familiar with the difficulties of getting specialty software written for any sort of automated control system. Increasing use of small and portable computers in mills also makes computer programming for professionals an important skill.

Management training and a master of business administration degree are perennial favorites for people trying to escape the "engineering ghetto," as this survey showed. The strong interest in additional education is interesting considering that 95% of the respondents were trained engineers. Some topics added to the list included flying, music, professional engineer license, and psychology.

UNPROMOTABLE PROFESSIONALS. Many nontechnical people in the industry start at entry-level jobs and progress through a series of positions and titles. Many engineers feel left out of this process because they do not generally receive as many in-house promotions as nonengineers.

A technical professional, educated in a specialized discipline, may be highly competent in his or her field and yet be unpromotable in the eyes of management. With each step upward, the number of available positions decreases. Also, the available slots for promotion in technical areas are often for people managers and not for "superengineers."

FIGURE 1: **Subjects in which engineers would like additional education.**


84% Management training (people skills)
63% Computer software/languages
41% Computer hardware
37% Master of business administration program
20% Accounting/business
19% Crossover degree in another engineering field
18% Master of science (or advanced degree) in your field
18% Writing/literature/liberal arts

This means that many talented professionals are stuck doing the job they were educated and trained to do. Promoting them, especially into management, would move them from an area in which they are productive to an area in which they may need extensive training. For those who may have studied engineering as a preparation for moving into management, this time spent "practicing" their profession can be very frustrating.

Technical professionals who feel stuck or at a dead end should ask themselves the following questions:

- Do I do my present technical/engineering job well? Am I qualified to do it by education, temperament, and training? Do I enjoy doing it in itself?

If you think you do your job well, put yourself in your company's shoes. Ask yourself why a competent, trained professional doing well in a department should be moved from that job to one in which previous training and education are only marginally helpful.

- Will the company be better off financially if I am moved or kept in this position?
- Is a company obligated to promote or move someone to enhance his or her career, even if it is detrimental to company interests?

Many engineers feel that professional experience is worth money to a company because it can save more than it costs. However, it is difficult to document such savings. An engineer could not easily prove that he or she has saved a firm money simply by having more years of experience than someone else.

Being a good professional engineer may require changing companies, moving into consulting, or realizing that the job you enjoy may have salary limitations. Moving into the more prestigious area of management sometimes means giving up your professional qualifications for a new set of values.

In most industries, a technical professional is trained to do a certain job and to do it well. Generally, other people in a company cannot do this person's job exactly and cannot easily be trained in-house to do it. Thus, companies will pay a premium for such professionals but will expect them to do their jobs for a considerable length of time before being promoted. The higher the starting salary, the longer the company's payback time.

Career paths work best when the company trains and educates the employee. But technical professionals are externally trained and normally hired as specialists. Thus, management tends to keep them in their areas of expertise as long as possible.

SALARY COMPRESSION. The following letter refers to an age-old problem in industries that pay fixed salaries. The problem, actually a dilemma, is commonly

known as salary compression. Most engineers become victims of salary compression at some point early in their careers. It happens when entry-level salaries for new engineers are driven up by market conditions that do not directly affect salaries of current employees. Engineers with only a few years of experience are most likely to be caught in the salary compression syndrome.

> *In efforts to maintain and develop the best existing engineering talents, how can employers hire new graduates at or above existing salaries? Salary averages for new graduates are well published, and comparisons on a locality and company basis can easily be made. When an engineer with two to four years of experience witnesses this occurrence firsthand, the natural question to ask is why.*
>
> *— Professional engineer, midwestern mill*

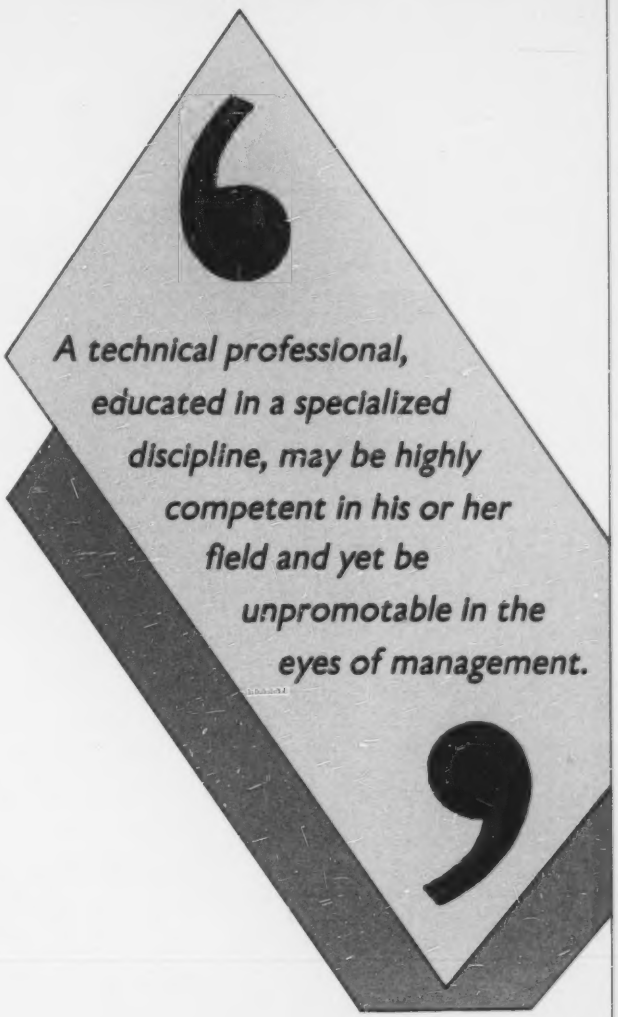
Job experience is the heart and core of most salary complaints. A very persuasive argument made by many people is that experience improves them and makes them better qualified to do their job or even someone else's job. This feeling has been a part of U.S. business culture since the industrial revolution and is a major factor behind union demands that seniority be the basis for promotion. From a company's perspective, however, experience is often one of the least quantifiable employee attributes.

Studies by management consultants have shown that engineers do not begin to "pay off" for a company until two to three years after graduation. It takes that long for a new engineer to adjust to the job and then learn enough about it to make useful contributions. This means that engineers need three to four years of experience before a raise can be truly justified.

Since most paper industry professionals have annual salary reviews (except during the recent business downturn), raises during these years are determined by company policy (not necessarily an engineer's productivity) and may well be below the current market rate. From a management viewpoint, engineers with zero to four years of experience may have equal value. A new graduate, with top qualifications, management potential, and good timing in a hot job market, could well start with a better salary than an engineer with experience. Once an engineer has five or more years of experience, however, the opportunities for growth seem to open up.

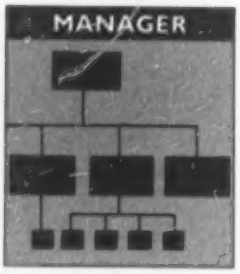
Like it or not, once a base salary is set, an engineer is usually stuck with it. Raises given will be a percentage of that amount until a real promotion is given. Salary erosion is compounded because companies usually don't make unilateral salary adjustments for existing employees to match changing market conditions. Internal promotions for the talented and the option of leaving for others provide a natural turnover of personnel.

FACING THE TRUTH. Engineers who are passed over for raises and promotions need to weigh the cost of changing jobs vs the cost of stagnation. Changing jobs with only two or three years of experience may not be a cure for salary limitations. Engineers with ten or more years of experience who have not moved into management express much less dissatisfaction with salary compression. Wage disparity between salaried and union scales is sometimes a problem, but it seems to have eased in recent years.


A technical professional, educated in a specialized discipline, may be highly competent in his or her field and yet be unpromotable in the eyes of management.

Engineers who seek management positions for the salary or prestige alone will find it tough going. The career choice for most engineers began before entering college. The years of education and training in technical matters will have to be put aside for other skills. People will have to become more important than facts if success as a manager is to be long lasting.

Success, promotions, and career advancements all come at a price. As a technical professional it is easy to lose sight of what is best for the individual. As one experienced engineer said, "I'd rather be a working engineer than a laid-off mill manager." ■



Pass Engineering Department: Take Extra Turn

ENGINEERS RISE TO THE CORPORATE LEVEL VIA PRODUCTION AND SALES

By MICHAEL J. DUCEY, Technical Editor

Survey of chief executives and vice presidents at paper companies traces career paths engineers have taken in higher education, work experience

■ How do engineers reach the corporate level? A recent *Pulp & Paper* survey of North American corporate officers found many former engineers among the top brass of pulp and paper companies. The survey was designed to identify the engineers who moved on to the corporate level by their engineering disciplines, technical and production experience, and the years it took to reach company headquarters. At the same time, and for general interest, the survey asked questions about compensation at the corporate level.

Figures 1 and 2 break down the executives by undergraduate disciplines, their graduate work (if any), and their previous primary job responsibility. Among the executives who were formerly engineers, the most popular undergraduate and graduate degrees were in chemical engineering (roughly 50% of bachelor of science respondents). A good portion of those degrees were from schools offering pulp and paper curricula as both a major and a minor.

The Institute of Paper Chemistry was found to be the leader among schools chosen by executives who studied technical disciplines after completing their undergraduate work. Physical science degree earners were also prevalent. The most popular major among these graduates was in forestry and forestry-related fields.

The survey found a wide variety of ages in the corporate office. For the most part, chief executives, chairmen, and presidents appear to have earned undergraduate degrees between the early 1940s and late 1950s, while most vice presidents seemed to have earned their undergraduate degrees in the 1950s.

The survey also showed that women have not reached executive status in pulp and paper companies. Reasons for this—aside from the relatively recent entry of women into the work force—include the age and slow movement of the paper industry as a whole. This will change. Women have entered pulp and paper undergraduate programs and gone on to become department heads and mill managers in great numbers during this decade.

EMPLOYMENT BACKGROUND. The executives surveyed held a myriad of job titles before filling their corporate roles. Among the chief executive officers, work experience seemed to be split fairly evenly between production and sales. These men were employed by their companies for a number of years before becoming the top executives.

Vice presidents moved up primarily from production supervisors, both as mill managers and divisional managers. They too have worked at their present company for at least ten years, but they have a more diversified employment record (particularly in production) in their company and in other companies. More than 90% have done most or all of their posteducation work inside the paper industry.

Discussions with a number of corporate officers disclosed a few similarities in the "climbs to the top." Technological developments seemed to push engineers into the limelight in their mill environment. For example, engineers are highly visible when a company moves competitively by increasing production. The invention

of the twin-wire former helped many young engineers gain recognition.

The chemical engineer is of particular importance since many process enhancements must come from that discipline. Other facets of production such as instrumentation and process control, both evolving greatly in the current and in earlier decades, have helped elevate the engineer's career potential.

A few executives mentioned the importance of "people skills" and their good rapport with subordinates during their mill working days. Others mentioned their extra activities and awards, such as becoming a certified professional engineer or an officer in an industry-sponsored group. All these factors seem to be relevant criteria for front office selection.

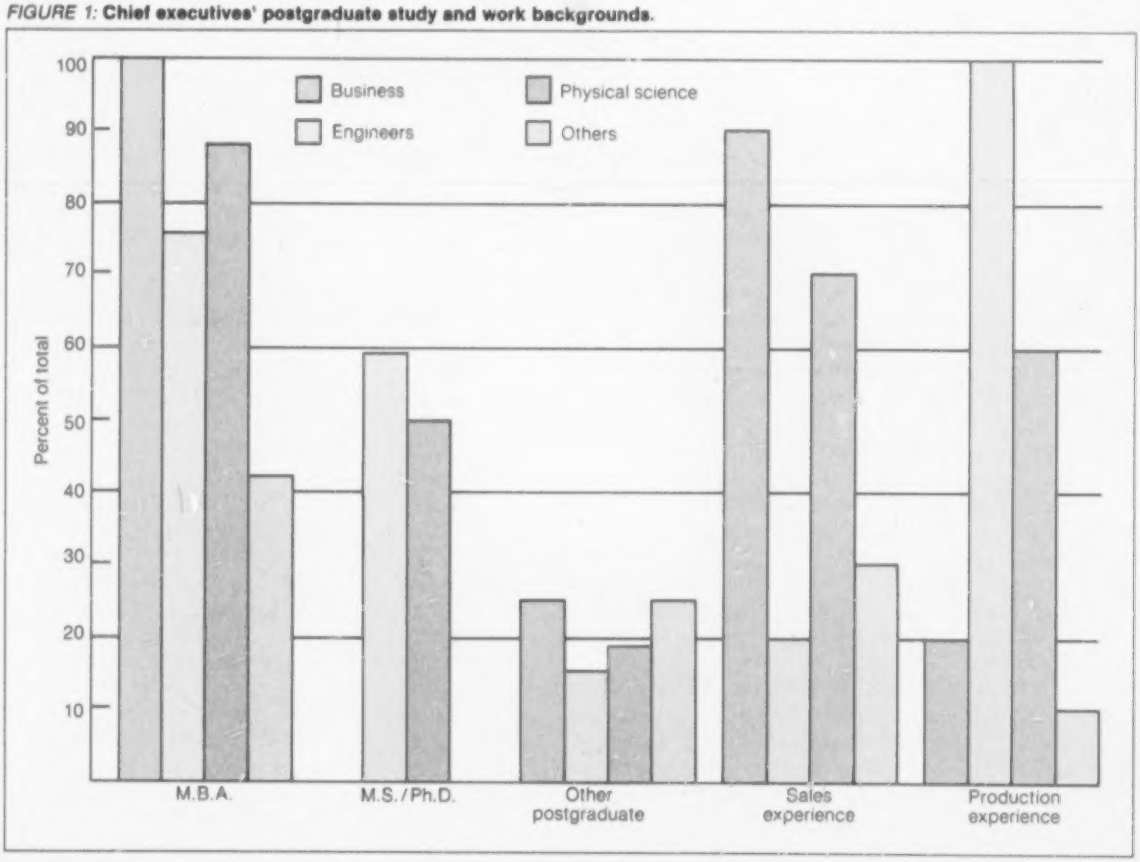
HEALTHY SALARY HIKES. Since the recession of 1981-82, salaries have increased steadily for all industry workers. Corporate officers have certainly enjoyed the bulk of these increases, as industry-sponsored surveys have revealed. Chief executives had a good year last year, having doubled their compensation in 1984. The average compensation last year for the top 20 chief executives in the pulp and paper industry was $881,000, a 50% increase over 1983.

Other corporate officers surveyed command salaries from $50,000 to over $100,000, depending upon position. Bonuses aside, the average annual increase over the last five years for these executives was around 12%. Each company has its own compensation system for upper management, and no clear way to break down these methods was sought.

THE FUTURE. First-year college entrants are enrolling in the sciences like never before. A tenth of all new enrollees plan to become engineers, while almost an equal amount seek computing degrees. Women are now the greater percentage of all higher education students, and they are gaining ground in the sciences as well. Schools are also invoking more cooperative education programs, realizing the need for practical training at the academic level.

TAPPI's Academic Relations Subcommittee recently disclosed survey results taken from 37 sustaining members which revealed that more than five engineers are hired for every scientist and nontechnical person hired.

FIGURE 1: **Chief executives' postgraduate study and work backgrounds.**



Among new professional staff members hired by these companies, a full 16% have come from the "paper schools." Table 1 breaks down the newly hired people during 1980 and 1984. The subcommittee also announced its efforts to have TAPPI gain acceptance into the Accreditation Board for Engineering & Technology in hopes of more clearly defining required curricula for a degree in the pulp and paper sciences.

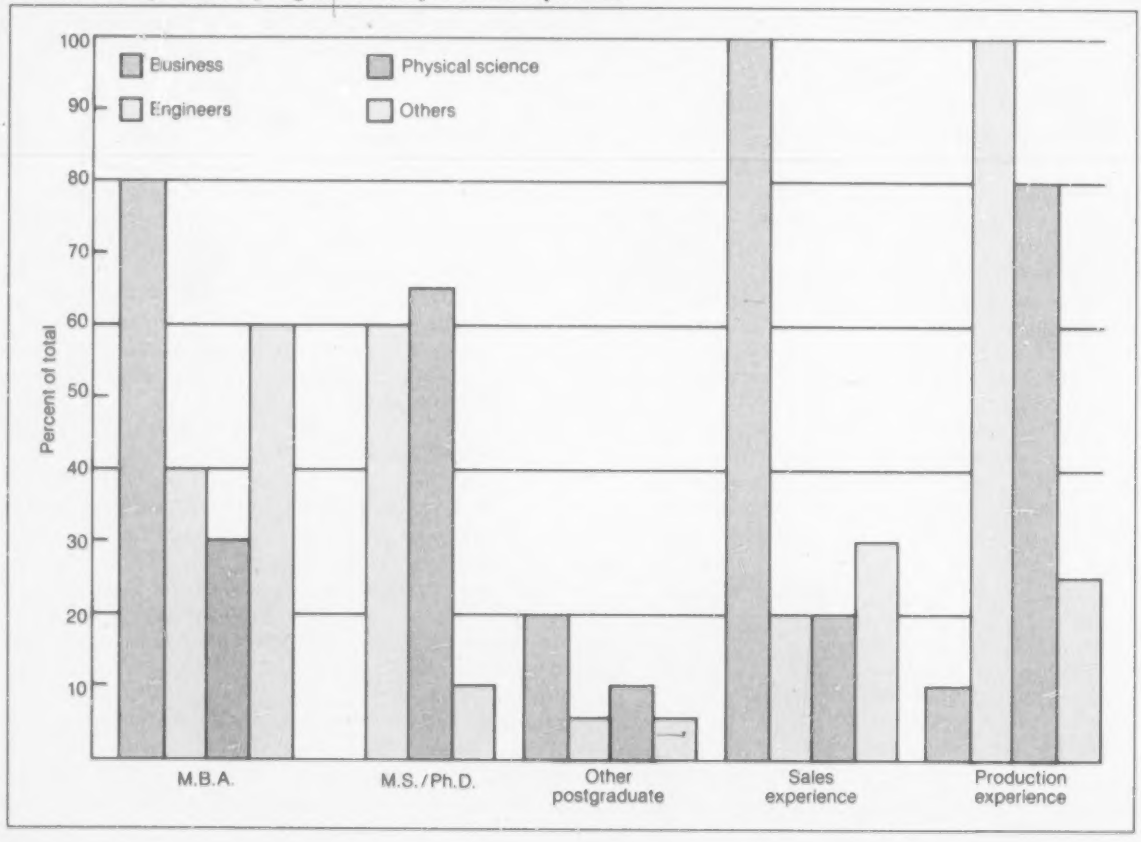
More than 100,000 new engineers and physical science students will graduate in 1985, the greatest number yet in the U.S. Of these, as many as 250 will hold degrees in the pulp and paper sciences, and approximately 85% of them will be employed after their first year out of school. About half of them will be hired by paper companies, and the remainder will serve in industry-related fields.

Of the talented engineers working today on the technology of tomorrow, many will find their way into a corporate position, primarily by moving into production or sales. Current officers enthusiastically claim that their employment record, strengthened and supported by their education and personal attributes, was the major force behind their movement to the corporate level. ■

TABLE 1: **New hires at 37 TAPPI sustaining member firms, 1980-84.**

	Engineers	Scientists	Non-technical	Total
All schools				
B.S.	410	74	75	559
M.S.	60	12	19	91
Ph.D.	15	34	—	49
Total	485	120	94	699
Paper schools				
B.S.	66	13	8	87
M.S.	12	9	3	24
Ph.D.	3	4	—	7
Total	81	26	11	118
Nonpaper schools				
B.S.	344	61	67	472
M.S.	48	3	16	67
Ph.D.	12	30	—	42
Total	404	94	83	581
Paper school hires (% of total)				
B.S.	16	18	11	16
M.S.	20	69	16	26
Ph.D.	20	12	—	14
Total	17	22	12	17

FIGURE 2: **Vice presidents' postgraduate study and work experience.**



NOTE

ONLY THE FOLLOWING PAGES OF THIS

PUBLICATION HAVE BEEN FILMED

Cov. 1, p. 3, 5, 9, 13, 27,

35, 37, 81-90.